PART 2

REPORT OF THE WORKING GROUP ON *NEPHROPS* STOCKS

Lowestoft, United Kingdom
2-9 March 1995

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

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5.11. Division VIIa (excluding 33E2-33E5) (Management Area J)

Functional Units: Irish Sea East (FU14); Irish Sea West (FU15)

The statistical rectangles comprising this Management Area and its constituent Functional Units are shown in Figure 5.1.2.

5.11.1. Irish Sea East (Functional Unit 14)

Data and Biological Inputs

Landings and effort statistics and length compositions of landings, catches, and discards were available for 1994. There were no new biological inputs (Table 5.11.1).

Comments on General Quality of Inputs

The quality of statistics collection was believed to be similar to previous years. Since *Nephrops* is a TAC species, the UK Fisheries Inspectorate attempt to census the landings and effort of all vessels landing in the UK. Following a revision of the landings by Ireland from this FU, the total international landings for 1985-90 have been amended with the addition of between 7 and 63 tonnes. The effort, CPUE, and LPUE series are based on directed *Nephrops* voyages, where the weight of *Nephrops* landed is more than 25% of the total landing. Following two years (1989,1990) without length samples, the sampling programme restarted in 1991 and has continued with 11 samples of landings and improved discard sampling with 34 samples of discards and catch in 1994 (Table 5.11.1).

Discard mortality, natural mortality, the length/weight relationships, and size at maturity are based on Irish Sea biological studies (Table 5.11.1). The growth inputs are based on those estimated for the western Irish Sea, with some adjustment, referring to comparable Scottish growth results, to take account of the larger size distribution in the eastern Irish Sea.

Landings

The eastern Irish Sea international landings fell to 515 t in 1994 (Table 5.11.2, Figure 5.11.1), well below the peak of 859 t in 1991, and some 13% below the 10 year mean of 589 t. Most of these landings were made into England, though the majority of them (58% of the directed landings) continue to be made by visiting Northern Irish vessels. Landings were made from April to September, when the fishery virtually stopped. The ratio of whole *Nephrops* to tails in the 1994 landings was 43% (on a whole weight equivalent basis) close to the mean (1987 to 1994) of 48%.

Fishing Effort

Fishing effort in 1994 by directed voyages (i.e. voyages where *Nephrops* account for >25% by weight of the landing), which accounted for 80% of the landings into England, decreased by 27% to 17300 trawling hours (Table 5.11.3, Figure 5.11.1), some 11% below the mean of 19400 trawling hours for the last 10 years.

Landings Per Unit Effort (LPUE)

It was not clear whether the reduction in LPUE observed in 1987-1989 was due to a reduction in stock abundance or to a change in discarding practice. The ratio of whole *Nephrops* to tails in the landings increased from 3:97 to about 50:50. This ratio has now remained at this level for some eight years, and the fluctuations in LPUE over this later period can be expected to reflect changes in abundance and availability. In 1994 the overall LPUE, based on *Nephrops*-directed voyages, increased by 22% to 22 kg/h trawling (Table 5.11.3, Figure 5.11.1), slightly above the 8 year mean of 20 kg/h, but below the long-term (1973-94) mean of 25 kg/h.

Mean Size

Sampling of the 1994 landings covered quarters 2 and 3, the period of the main fishery, with a total of 11 samples (Table 5.11.1). The mean sizes of 33.9 and 32.9 mm CL for males and females respectively were below those estimated for last year (Table 5.11.4, Figure 5.11.1), possibly as a result of less discarding. Mean landing sizes have fluctuated without trend since 1985. Catch mean sizes have been estimated for 1991-1994, and have increased recently (Table 5.11.4, Figure 5.11.1). The mean size of the discards increased slightly in 1994 (Table 5.11.4), possibly due to an increase in the mesh size in use. There was a noticeable lack of *Nephrops* <18mm CL in the 1994 discard samples.

Assessments

Length-based Assessment

Last year's LCA was updated with the 1994 landings and discard data. There were no new biological data and the input parameters remained unchanged, except that terminal F for the females was reduced to 0.16 to equate with the last few F values.

Annualised mean F values for the inter-quartile range of the length range were 0.46 for males and 0.17 for females (Tables 5.11.5 and 5.11.6). The addition of the 1994 data made little difference to the Y/R and B/R curves, compared with the previous assessments (Figure 5.11.2). The female long-term Y/R curve is flat topped, with current F a little below Fmax. For males the LCA suggests that current F is above Fmax, though the Y/R curve is also flat topped.

Age-based assessment

The time series of length compositions of the landings is relatively short and, in particular, there is a gap with no data for 1989 and 1990. The data were considered to be inadequate for an annual age-based assessment.

General Comments on the Quality of the Assessment

There have been some improvements in the sampling of the length distributions of both landings and discards. The data series is still fragmented, with usable discard data only available for the last four years. The quality of some of the biological data is dependent upon inputs from other functional units (Table 5.11.1). As the long-term Y/R curves are flat-topped, Y/R is relatively insensitive to quite large changes in fishing effort. The LCA provides an acceptable guide to the state of exploitation of this functional unit. Only major changes to the length data or biological inputs would be likely to change the perception of the state of exploitation and influence the choice of appropriate management measures.

Management Considerations

The LCA has been used in the past as a guide to the state of exploitation. The slight changes in this year's LCA do not change the view that, for sexes combined, the current F is close to Fmax, and fishing effort should not be allowed to increase. A *status quo* effort option is suggested for 1996.

5.11.2. Irish Sea West (Functional Unit 15)

Data and Biological Inputs

As in 1994 the data used for the assessment of FU15 were numbers of *Nephrops* landed, caught and discarded in samples taken by Ireland and Northern Ireland. These data were raised to total numbers using the landed tonnage. There were no changes to the biological input parameters (Table 5.11.7).

UK (Northern Ireland)

Around 80% of the Northern Ireland *Nephrops* landings are as tails for the 'scampi' market (81% in 1994), the remainder are landed as whole *Nephrops*. The carapace length distribution of these landings are obtained by sampling the discarded heads or cephalothorax from samples taken at sea on commercial vessels. For each haul sampled approximately 50 kg of total catch and 50 kg of discards are sampled. Landings at length of tailed animals were obtained by raising carapace length composition of detached heads to the tonnage of tails landed. These data are then used to provide a raising factor to apply to the sample data to calculate the number and weight of *Nephrops* discarded. Length compositions from total catch samples were raised to the combined weight of whole and tailed *Nephrops* landed plus the calculated weight discarded. The size composition of landings i.e. tailed and whole combined, was therefore obtained by subtracting the discard length compositions from the raised total catch size composition. The time series of length data for Northern Ireland was revised using this method over the period 1986-1994. This revision in raising methodology was introduced because of poor sampling of the fraction of the catch landed whole in recent years.

Republic of Ireland

As usual *Nephrops* samples were collected in four parts, unsorted catch, undersized whole discards, discarded 'heads' of those *Nephrops* landed as tails, whole 'jumbo' (large) *Nephrops* and occasionally small whole *Nephrops*. Since it is difficult to ascertain from the landings statistics how much of the *Nephrops* landed whole are large (thought to be >85%), the sampling procedure is used to create a discarding ogive from samples of discarded whole *Nephrops* and heads, and this is then used to divide the sample of unsorted catch into discarded and landed portions. Length frequency distributions were obtained for male, and for immature and mature females. Details of sampling levels are given in Table 5.11.7.

Comments on General Quality of Inputs

Sampling of catches, landings and discards by Northern Ireland was sustained during 1994 at levels similar to those achieved in earlier years. Although effort data were available for Northern Irish vessels there was concern that a move to twin-rig gear by some vessels would show an artificial inflation of CPUE. This should be rectified in future years by the introduction of logbooks gear codes during 1994 that will enable effort data by single and twin-rig vessels to be separated.

For the Republic of Ireland the quality of landings statistics is believed to be similar to last year, though an increase in speed of collection has occurred due to computerisation. However, the system is not yet totally reorganised, so that it is still difficult to ascertain with complete confidence whether all the Howth landings are in fact caught in FU 15. It is believed, however, that amounts involved would be very small, and it is anticipated that this problem will be rapidly solved as standard procedures are developed for operating the statistics collection programs.

Landings are recorded in only two categories, 'whole' and 'tails' and the extent of the small proportion of the whole *Nephrops* belonging to the 'small' size category is difficult to ascertain.

Discard mortality, natural mortality, size of maturity and growth parameters are based on Irish Sea biological studies, while length/weight relationships are derived from Scottish data (Table 5.11.7).

Landings

Total international *Nephrops* landings from FU 15 in 1994 were 7322 t, which is 10% lower than the 1993 value of 8111 t (Table 5.11.8, Figure 5.11.3). Landings by Northern Ireland vessels were 5480 t, 75% of the total landings and 97% of the UK landings. Northern Ireland landings consisted of 19% tailed *Nephrops* and 81% whole animals. Republic of Ireland landings for the reference period (1985-1994) have been revised and are included in Table 5.11.8. These have shown a downward trend in recent years with 1644 t being landed in 1994 a reduction of 39% compared with 1993.

Effort

Northern Ireland effort data has shown a downward trend since 1992 (Table 5.11.9). This drop could partly be explained by the decommissioning of around 30 vessels from a Northern Ireland fleet of over 150 vessels in 1993 coupled with a move to the more efficient twin-rig gear by a number of vessels.

LPUE/CPUE

LPUE and CPUE for the Northern Ireland fleet, calculated as liveweight per hour of fishing, dropped to its lowest value in 1992, has apparently risen again in 1993 and 1994 (Table 5.11.9 and Figure 5.11.3). As from mid-1994 new gear codes were introduced which enables landings and effort data from twin-rig and single-rig gears to be captured separately. This should provide a more meaningful view of CPUE trends for presentation at the 1996 meeting. The reduction in landings by Ireland is thought to be due to a shift of effort away from the Irish Sea which suggests that there has been an overall reduction in effort in this Functional Unit.

A more detailed analysis of CPUE by sex is presented in Figure 5.11.4. Analysis of quarterly Northern Ireland effort data showed effort to be high during the summer months when female *Nephrops* are most available for capture. Annual CPUEs are therefore only comparable if the seasonal distribution of effort is constant, as discussed in the *Nephrops* Study Group report (Anon., 1994a).

Mean sizes

The mean size of *Nephrops* in catches (landings plus discards) by both the Northern Ireland and Republic of Ireland fisheries have been relatively stable over recent years with a slight rise in 1994 (Tables 5.11.10, Figure 5.11.3, and Table 5.11.11). The 1992-1994 data from Ireland suggested that the decline in mean size of landed *Nephrops* has stopped and is accompanied by a stabilisation of the proportion discarded (see text table), i.e. size selection by fishermen has stabilised since the minimum landing size was reduced.

Year	% Discards
1984	43
1985	40
1986	34
1987	29
1988	24
1989	24
1990	16
1991	20
1992	19
1993	21
1994	14

Assessment

Length-based assessment

The length based assessment performed at the 1991 meeting was updated by including recent data giving an averaged time series of length compositions of males and females for the 9 year period 1986-1994 for both Northern Ireland and Ireland fleets. Input parameters were as used in 1991 and are presented in Table 5.11.7. Fishing mortalities averaged over the middle 50% of the length range were 0.76 and 0.51 for males and females respectively (Tables 5.11.12 and 5.11.13). These values are similar to those given by the VPA. The Y/R curves for males and females (Figure 5.11.5) is relatively flat topped with current F above Fmax for both sexes.

Age-based assessment

A multi-fleet assessment tuned by the Northern Ireland effort data was performed using the same input parameters used in the 1993 assessment on the revised 1986-1994 data. The revised Northern Ireland and Ireland size composition data for total removals were sliced into nominal ages, using the L2AGE program. Total removals (landings + 90% of discards) represent the total estimated *Nephrops* taken from the stock by the fishery, assuming a discard mortality of 90%. These data were used to carry out Laurec/Shepherd tuned multi-fleet assessments (as in 1994) of male and female *Nephrops* separately using Northern Ireland and Republic of Ireland data for the period 1986-94. The Northern Ireland effort data were used for tuning with Q fixed, while the Republic of Ireland data (no effort series) were excluded. Historical F was included and mean F (Fbar) was calculated for nominal age classes 3-

5. Tables 5.11.14 and 5.11.15 show tuning output data for males and females respectively.

Males

Table 5.11.16 shows the inputs of proportion mature, catch numbers and the mean weight of male *Nephrops* at each nominal age, and the VPA outputs. The F-at-age values are generally high, though not so high as those given by the 1994 assessment (Anon., 1994b). Mean F(3-5) appears to fluctuate between 0.7 to 0.9 (Table 5.11.16, Figure 5.11.7), and is similar to that given by the LCA. The correlation of F(3-5) with fishing effort is poor ($r^2 = 0.01$, $P>0.1$) (Figure 5.11.6). The assessment suggests that apart from an increase in 1993, stock biomass shows a slight declining trend, and recruitment has been stable over the time series (Table 5.11.16, Figure 5.11.7).

Females

Table 5.11.17 shows the inputs of proportion mature, catch numbers and the mean weight of male *Nephrops* at each nominal age, and the VPA outputs. Fbar(3-5) has fluctuated between 0.6 and 0.8 (Table 5.11.17, Figure 5.11.9), with similar values to those generated by the LCA. The correlation of F(3-5) with fishing effort is poor ($r^2 = 0.005$, $P>0.1$) (Figure 5.11.8). The assessment suggests that total stock biomass and recruitment have been relatively stable over the time series (Table 5.11.17, Figure 5.11.9).

General Comments on the Quality of the Assessment

A new procedure for raising Northern Ireland catch at length sample data provided revised length compositions for the time series. The F values generated by the multi-fleet assessment based on length slicing were generally similar to those from the analysis of Republic of Ireland length compositions for male *Nephrops* using the MIX programme (see 4.4.2). The planned improvement to Northern Ireland effort data by disagregating single and multi-rig data should improve the quality of VPA tuning.

Management Considerations

Results from the age-based analysis did not conflict strongly with those from the LCA. The fishing mortalities generated by the 1995 assessment appear to be lower than those predicted by the 1994 assessment. This may partly be due to the effect of the revised Northern Ireland length composition data on the assessment. The LCA results gave a relatively flat topped Y/R curve and suggested that the current level of F was about 20-30% beyond Fmax for both males females. Although the Northern Ireland data have not been corrected for the increasing number of multi-rig vessels since the early nineties, the total number of hours fished appears to have been reduced. A diversion of effort by Irish vessels away from the Irish Sea in recent years suggests that there has been an overall reduction in fishing effort.

Even though the methods used indicate relatively high levels of fishing mortality, the sustained catches and stable recruitment, together with evidence of effort reduction by the Irish fleet led the meeting to suggest *status quo* management advice for FU 15. In view of uncertainties in the assessment and the increasing use of twin-rig vessels by the Northern Ireland fleet it is important that the situation is monitored closely.

5.11.3. Summary of Division VIIa (excluding 33E2-33E5) (Management Area J)

Summaries of the recent landings from this Management Area are given by Functional Unit and Country in Tables 5.11.18 and 5.11.19. As the overall advice for both FU14 and FU15 is to prevent an effort increase, *status quo* management is recommended for Management Area J.

Table 5.11.1 Input data and parameters: Irish Sea east

FU	14	MA	J
FLEET	UK	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch	0	10	24	0	263
Landings	0	5	6	0	177
Discards	0	10	24	0	43

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch	34	9	12	11	0	0	0	0	0	0
Landings	11	20	27	13	3	3	18	17	24	25
Discards	34	9	12	11	0	0	0	0	0	0

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	0.25	Anon, 1985
MALES		
Growth - K	0.16	Irish Sea West data and Bailey and Chapman 1983
Growth - L(inf)	60	"
Nat. Mort. - M	0.3	Brander and Bennett, 1986,1989
Length/weight - a	.00029	Bennett, 1983
Length/weight - b	2.94	"
FEMALES		
Immature Growth		
K	0.16	as growth above
L(inf)	60	
Nat.Mort. - M	0.3	Brander and Bennett, 1986,1989
Size at Maturity	24	Briggs, 1988
Mature Growth		
K	0.1	as growth above
L(inf)	56	
Nat.Mort. - M	0.2	Brander and Bennett, 1986, 1989
Length/weight - a	.00029	Bennett, 1983
Length/weight - b	2.92	"

Table 5.11.2 Irish Sea East (Functional Unit 14): Landings (tonnes) by country, 1985-94

Year	UK	Isle of Man	Ireland	Total
1985	519		22	541
1986	686		42	728
1987	471		63	534
1988	497		19	516
1989	431		7	438
1990	630		14	644
1991	840		19	859
1992	484		11	495
1993	583		35	618
1994*	477	9	29	515

* provisional

Table 5.11.3 Irish Sea East (Functional Unit 14): Effort ('000 hours trawling) and LPUE in kg/hr trawling of Nephrops directed voyages by UK trawlers, 1985-94

Year	Effort	LPUE
1985	15.2	29
1986	19.3	29
1987	23.3	15
1988	19.7	18
1989	18.5	17
1990	17.8	24
1991	20.0	26
1992	18.6	20
1993	23.8	18
1994*	17.3	22

* provisional

Table 5.11.4 Irish Sea East (Functional Unit 14): Mean sizes (CL mm) of male and female Nephrops from UK vessels landing in England and Wales, 1985-94

	Catch		Landings		Discards	
Year	Males	Females	Males	Females	Males	Females
1985	na	na	32.0	29.3	na	na
1986	na	na	32.2	29.5	na	na
1987	na	na	35.9	32.5	na	na
1988	na	na	37.9	36.4	na	na
1989	na	na	na	na	na	na
1990	na	na	na	na	na	na
1991	30.0	29.5	32.1	33.5	26.9	26.6
1992	30.1	30.5	32.2	32.8	26.9	26.0
1993	31.6	30.6	35.0	34.6	26.7	26.5
1994	33.2	32.3	33.9	32.9	28.2	28.1

na = not available

Table 5.11.5 Irish Sea East (FU14): Males - LCA output

COHORT ANALYSIS

L INFINITY = 60.0000 K = .1600

COHORT ANALYSIS BY POPE'S APPROXIMATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
14.0	1917.0	.3000	.2778	.0000	.0001	.3001	52822350.0	14080080.0	11714170.0
16.0	45249.8	.3000	.2908	.0010	.0033	.3033	48596410.0	13524260.0	16256660.0
18.0	67376.3	.3000	.3049	.0016	.0052	.3052	44493870.0	12955650.0	21596980.0
20.0	148777.8	.3000	.3206	.0039	.0120	.3120	40539770.0	12367480.0	27669670.0
22.0	816913.5	.3000	.3379	.0237	.0702	.3702	36680680.0	11651260.0	34060500.0
24.0	1794452.0	.3000	.3572	.0603	.1687	.4687	32367870.0	10646870.0	39770760.0
26.0	2480933.0	.3000	.3789	.1008	.2661	.5661	27377530.0	9336326.0	43730410.0
28.0	3426521.0	.3000	.4034	.1801	.4464	.7464	22091990.0	7694806.0	44467820.0
30.0	2864298.0	.3000	.4312	.2069	.4798	.7798	16348720.0	5986757.0	42091370.0
32.0	2491788.0	.3000	.4632	.2597	.5606	.8606	11680010.0	4461716.0	37699100.0
34.0	1671652.0	.3000	.5003	.2611	.5220	.8220	7840206.0	3215799.0	32303310.0
36.0	1095057.0	.3000	.5438	.2596	.4773	.7773	5196785.0	2304757.0	27260650.0
38.0	892064.8	.3000	.5957	.3375	.5666	.8666	3405220.0	1584459.0	21878080.0
40.0	526514.0	.3000	.6585	.3369	.5116	.8116	2032147.0	1036629.0	16580810.0
42.0	367427.0	.3000	.7361	.4224	.5739	.8739	1190867.0	646547.3	11895850.0
44.0	213585.0	.3000	.8346	.4890	.5859	.8859	625873.0	369183.4	7763992.0
46.0	113242.0	.3000	.9634	.5761	.5980	.8980	298796.2	192662.6	4604297.0
48.0	61738.0	.3000	1.1395	.8730	.7661	1.0661	125790.5	82976.8	2241461.0
50.0	12555.0	.3000	1.3946	.5354	.3839	.6839	37330.3	33554.1	1019530.0
52.0	6580.0	.3000	1.7980	.9142	.5084	.8084	14382.1	13632.0	463797.0
54.0	2101.0	.3000			.5000	.8000	3361.6	13632.0	463797.0
							TOTALS	112199100.0	445533100.0

NOTE: AVE. POP. & BIOMASS LARGEST LENGTH ASSUMED TO EQUAL THOSE OF PENULTIMATE LENGTH

Table 5.11.6 Irish Sea East (FU14): Females - LCA output

COHORT ANALYSIS

LOWER CURVE LINF= 60.0000 K= .1600

UPPER CURVE LINF= 56.0000 K= .1000

TRANSITION LENGTH= 24.0000

COHORT ANALYSIS BY POPE'S APPROXIMATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
10.0	9519.8	.3000	.2551	.0001	.0004	.3004	99458280.0	24427480.0	7782933.0
12.0	9519.8	.3000	.2660	.0001	.0004	.3004	92120530.0	23550390.0	12221120.0
14.0	2490.0	.3000	.2778	.0000	.0001	.3001	85045900.0	22669530.0	17865990.0
16.0	213186.0	.3000	.2908	.0029	.0098	.3098	78242540.0	21754570.0	24709240.0
18.0	226076.0	.3000	.3049	.0033	.0109	.3109	71502910.0	20802400.0	32694300.0
20.0	263409.8	.3000	.3206	.0043	.0133	.3133	65036020.0	19836660.0	41758700.0
22.0	1146129.0	.3000	.3379	.0207	.0613	.3613	58821500.0	18711520.0	51375070.0
24.0	3033118.0	.3000	.3572	.0634	.1776	.4776	52061220.0	17098340.0	59887590.0
26.0	4014958.0	.2000	.6899	.1031	.1495	.3495	43895440.0	26910090.0	118003600.0
28.0	3669428.0	.2000	.7411	.1217	.1642	.3642	34490510.0	22401340.0	121024700.0
30.0	3619874.0	.2000	.8004	.1613	.2015	.4015	26331940.0	18025740.0	118322500.0
32.0	2781608.0	.2000	.8701	.1731	.1989	.3989	19095260.0	14038200.0	110603900.0
34.0	2538176.0	.2000	.9531	.2318	.2432	.4432	13495510.0	10491280.0	98153420.0
36.0	1656782.0	.2000	1.0536	.2333	.2215	.4215	8845883.0	7525892.0	82814260.0
38.0	1148962.0	.2000	1.1778	.2585	.2195	.4195	5674061.0	5273466.0	67671050.0
40.0	609898.0	.2000	1.3353	.2248	.1684	.3684	3461909.0	3651382.0	54223090.0
42.0	327612.8	.2000	1.5415	.1991	.1292	.3292	2116863.0	2559176.0	43674320.0
44.0	226350.5	.2000	1.8232	.2397	.1315	.3315	1274436.0	1743874.0	33985510.0
46.0	127836.0	.2000	2.2314	.2607	.1168	.3168	696399.3	1114133.0	24652490.0
48.0	87935.0	.2000	2.8768	.4176	.1452	.3452	343426.7	626350.3	15652650.0
50.0	56545.0	.2000			.1600	.3600	127226.3	626350.3	15652650.0
							TOTALS	283838200.0	1152729000.0

NOTE: AVE. POP. & BIOMASS LARGEST LENGTH ASSUMED TO EQUAL THOSE OF PENULTIMATE LENGTH

Table 5.11.7 Data and input parameters: Irish Sea West

FU	15	MA	J
FLEET	UK N Ireland	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch	9	5	9	5	195
Landings	9	5	9	5	193
Discards	9	5	9	5	74

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch	28	52	35	59	57	68	57	67	58	79
Landings	28	52	35	59	57	68	57	67	58	79
Discards	28	52	35	59	57	68	57	67	58	79

FLEET	Rep. Ireland	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch	5	9	15	8	478
Landings	4	9	15	8	560
Discards	4	9	15	8	181

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch	37	27	31	30	33	41	38	34	18	23
Landings	36	24	30	29	35	38	29	16	18	21
Discards	36	26	31	27	34	35	31	22	21	26

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	0.1	Anon. 1991 (expected high predation by cod)
MALES		
Growth - K	0.16	Hillis, 1979 and Anon.,1991
Growth - L(inf)	60	"
Nat. Mort. - M	0.3	Brander and Bennet,1986,1989
Length/weight - a	0.00032	Pope and Thomas, 1955 (Scottish stocks)
Length/weight - b	3.21	"
FEMALES		
Immature Growth		
K	0.16	Hillis,1979 and Anon.,1991
L(inf)	60	"
Nat.Mort. - M	0.3	as for males
Size at Maturity	24	Briggs, 1988
Mature Growth		
K	0.1	Hillis,1979 and Anon.1991
L(inf)	56	"
Nat.Mort. - M	0.2	as for males
Length/weight - a	0.00068	"
Length/weight - b	2.96	"

Table 5.11.8 Irish Sea West (Functional Unit 15): Landings (tonnes) by country, 1985-94

Year	UK	Ireland	Isle of Man	France	Total
1985	4394	2004	3	42	6443
1986	5243	3539	7	93	8882
1987	5043	4215	18	55	9331
1988	5283	2946	39	62	8630
1989	5580	2477	8	19	8084
1990	5535	2710	25	8	8278
1991	6024	3371	61	12	9468
1992	5112	2370	14	6	7502
1993	5356	2715	32	8	8111
1994*	5670	1644	7	1	7322

* Provisional

Table 5.11.9 Irish Sea West (Functional Unit 15): Catches and landings (tonnes), effort ('000 hours trawling, CPUE and LPUE (kg/hr) of Northern Ireland Nephrops trawlers, 1985-94

Year	Catches	Landings	Effort	CPUE	LPUE
1985	5442	4310	119.1	45.7	36.2
1986	6194	5197	152.2	40.7	34.1
1987	5775	4990	164.5	35.1	30.3
1988	5712	5220	156.4	36.5	33.4
1989	5945	5517	191.4	32.2	28.8
1990	5679	5505	189.9	29.9	29.0
1991	6132	5925	200.6	30.6	29.5
1992	5692	5058	194.1	29.3	26.1
1993	6085	5295	184.1	33.1	28.8
1994*	6259	5480	176.3	35.5	31.1

* provisional

Table 5.11.10 Irish Sea West (Functional Unit 15): Mean sizes (CL mm) of males and females in Northern Ireland catches, landings and discards, 1985-94

Year	Catch		Landings		Discards	
	Male	Female	Male	Female	Male	Female
1985	25.9	23.0				
1986	26.5	23.6				
1987	26.8	23.9				
1988	27.5	24.5				
1989	26.4	23.8				
1990	26.3	24.0				
1991	26.6	25.2				
1992	26.7	24.9				
1993	25.5	23.5				
1994	25.9	23.7				

Table 5.11.11 Irish Sea West (Functional Unit 15) : Mean carapace lengths (mm) of Republic of Ireland catches, landings and discards, 1985-94

Year	Republic of Ireland		
	catch	landings	discards
1985	25.8	28.9	23.4
1986	26.2	28.6	23.2
1987	26.5	28.9	22.9
1988	27.2	28.9	23.7
1989	26.6	27.9	23.8
1990	26.4	27.3	22.9
1991	26.1	27.2	23.0
1992	26.5	27.7	22.9
1993	25.8	27.3	22.2
1994	26.1	27.3	22.0

Table 5.11.12 Irish Sea West (FU15): Males - LCA output

COHORT ANALYSIS
L INFINITY = 60.0000 K = .1600
COHORT ANALYSIS BY POPE'S APPROXIMATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
11.0	31.1	.3000	.1289	.0001	.0005	.3005	484865.6	61290.6	49817.7
12.0	76.7	.3000	.1316	.0002	.0013	.3013	466447.4	60176.2	63922.8
13.0	90.8	.3000	.1344	.0002	.0015	.3015	448317.8	59055.2	80311.8
14.0	164.1	.3000	.1374	.0004	.0028	.3028	430510.4	57925.4	99085.6
15.0	508.5	.3000	.1405	.0013	.0090	.3090	412968.6	56763.0	120276.4
16.0	1071.1	.3000	.1437	.0028	.0193	.3193	395431.3	55533.7	143823.6
17.0	2208.2	.3000	.1471	.0060	.0408	.3408	377700.0	54177.9	169482.1
18.0	4252.3	.3000	.1506	.0122	.0809	.3809	359238.2	52582.1	196611.5
19.0	6491.9	.3000	.1543	.0198	.1282	.4282	339210.7	50657.8	224288.6
20.0	9971.0	.3000	.1582	.0327	.2066	.5066	317520.3	48282.4	250997.3
21.0	13371.1	.3000	.1623	.0479	.2949	.5949	293062.3	45352.4	274712.1
22.0	7463.8	.3000	.1667	.0292	.1751	.4751	266081.6	42639.1	298857.1
23.0	19118.5	.3000	.1712	.0832	.4856	.7856	245824.4	39387.0	317417.8
24.0	21550.0	.3000	.1761	.1087	.6172	.9172	214880.9	34936.9	321852.7
25.0	21534.6	.3000	.1812	.1290	.7120	1.0120	182837.0	30265.6	317025.3
26.0	19092.1	.3000	.1866	.1381	.7402	1.0402	152207.5	25813.1	305921.1
27.0	17621.1	.3000	.1923	.1563	.8126	1.1126	125356.7	21704.1	289700.8
28.0	15357.5	.3000	.1984	.1700	.8567	1.1567	101208.6	17944.7	268620.4
29.0	12052.7	.3000	.2049	.1678	.8189	1.1189	80452.5	14733.9	246375.4
30.0	10723.3	.3000	.2119	.1900	.8968	1.1968	63967.4	11971.7	222797.1
31.0	7569.1	.3000	.2193	.1715	.7819	1.0819	49640.0	9691.8	200047.4
32.0	6484.5	.3000	.2273	.1880	.8270	1.1270	39154.8	7851.3	179159.4
33.0	4881.4	.3000	.2359	.1826	.7740	1.0740	30306.7	6315.1	158825.7
34.0	3946.2	.3000	.2451	.1912	.7800	1.0800	23524.6	5066.4	140038.2
35.0	3026.7	.3000	.2551	.1914	.7502	1.0502	18052.9	4040.5	122411.0
36.0	2167.5	.3000	.2660	.1783	.6705	.9705	13809.6	3237.5	107231.1
37.0	1845.9	.3000	.2778	.1989	.7161	1.0161	10667.8	2582.2	93277.3
38.0	1275.6	.3000	.2908	.1811	.6229	.9229	8044.1	2051.3	80633.3
39.0	892.5	.3000	.3049	.1647	.5403	.8403	6151.0	1654.7	70621.2
40.0	709.8	.3000	.3206	.1701	.5307	.8307	4760.7	1339.9	61965.3
41.0	637.5	.3000	.3379	.2032	.6012	.9012	3647.7	1062.6	53145.2
42.0	457.5	.3000	.3572	.1978	.5536	.8536	2690.0	828.3	44716.1
43.0	225.6	.3000	.3789	.1283	.3386	.6386	1983.0	667.4	38821.4
44.0	217.8	.3000	.4034	.1609	.3989	.6989	1556.8	547.2	34240.7
45.0	145.0	.3000	.4312	.1412	.3276	.6276	1174.4	443.7	29813.8
46.0	73.0	.3000	.4632	.0914	.1973	.4973	895.9	370.7	26708.0
47.0	60.0	.3000	.5003	.0953	.1905	.4905	711.6	315.7	24355.1
48.0	42.0	.3000	.5438	.0854	.1570	.4570	556.8	268.1	22114.1
49.0	74.0	.3000	.5957	.2062	.3462	.6462	434.3	214.7	18910.0
50.0	35.0	.3000	.6585	.1401	.2128	.5128	295.5	165.1	15509.4
51.0	23.0	.3000	.7361	.1299	.1765	.4765	210.8	130.9	13092.1
52.0	22.0	.3000	.8346	.1839	.2203	.5203	148.5	100.5	10691.7
53.0	25.0	.3000	.9634	.3572	.3708	.6708	96.2	68.2	7712.7
54.0	14.0	.3000	1.1395	.3999	.3509	.6509	50.4	40.5	4862.9
55.0	12.0	.3000			.3000	.6000	24.0	.0	.0
			TOTAL BIOMASS INCLUDES LENGTHS ABOVE			+GP	890247.4		5820800.0

Table 5.11.13 Irish Sea West (FU15): Females - LCA outputs

LOWER CURVE LINF= 60.0000 K= .1600
UPPER CURVE LINF= 56.0000 K= .1000

TRANSITION LENGTH= 24.0000

COHORT ANALYSIS BY POPE'S APPROXIMATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
10.0	7.7	.3000	.1263	.0000	.0002	.3002	398056.8	49320.9	35339.5
11.0	27.8	.3000	.1289	.0001	.0006	.3006	383252.8	48445.7	45439.1
12.0	93.8	.3000	.1316	.0003	.0020	.3020	368691.3	47562.6	57098.9
13.0	170.9	.3000	.1344	.0005	.0037	.3037	354328.7	46667.7	70358.0
14.0	307.2	.3000	.1374	.0009	.0067	.3067	340157.4	45756.3	85233.2
15.0	858.5	.3000	.1405	.0027	.0192	.3192	326123.2	44794.2	101651.3
16.0	1867.1	.3000	.1437	.0061	.0427	.3427	311826.5	43719.4	119381.1
17.0	3360.3	.3000	.1471	.0116	.0791	.3791	296843.4	42460.7	138003.1
18.0	6558.8	.3000	.1506	.0242	.1606	.4606	280744.4	40849.6	156503.8
19.0	10008.9	.3000	.1543	.0399	.2585	.5585	261929.6	38730.2	173404.8
20.0	14953.5	.3000	.1582	.0658	.4161	.7161	240299.2	35948.9	186632.0
21.0	17391.4	.3000	.1623	.0867	.5341	.8341	214555.7	32577.0	194732.3
22.0	21948.1	.3000	.1667	.1279	.7676	1.0676	187383.3	28611.3	195662.3
23.0	23396.0	.3000	.1712	.1661	.9701	1.2701	156837.8	24137.5	187742.7
24.0	22931.7	.3000	.1761	.2065	1.1730	1.4730	126181.4	19569.3	172193.0
25.0	19597.5	.2000	.3279	.2332	.7112	.9112	97355.3	27595.1	273338.1
26.0	14615.8	.2000	.3390	.2349	.6930	.8930	72210.3	21122.0	234450.5
27.0	11025.8	.2000	.3509	.2409	.6864	.8864	53347.9	16088.7	199275.8
28.0	7885.2	.2000	.3637	.2347	.6454	.8454	39086.5	12237.3	168475.6
29.0	5300.6	.2000	.3774	.2126	.5633	.7633	28740.8	9424.3	143691.9
30.0	3763.3	.2000	.3922	.2005	.5111	.7111	21547.0	7374.8	124103.5
31.0	2436.5	.2000	.4082	.1692	.4145	.6145	16302.9	5886.0	108975.5
32.0	1959.4	.2000	.4256	.1758	.4130	.6130	12685.7	4752.2	96511.1
33.0	1244.1	.2000	.4445	.1428	.3213	.5213	9772.8	3877.6	86139.2
34.0	1012.1	.2000	.4652	.1471	.3162	.5162	7751.4	3205.7	77691.7
35.0	652.4	.2000	.4879	.1192	.2443	.4443	6096.7	2674.3	70532.8
36.0	493.3	.2000	.5129	.1118	.2180	.4180	4908.6	2266.2	64891.1
37.0	406.3	.2000	.5407	.1146	.2119	.4119	3961.3	1920.0	59559.2
38.0	255.2	.2000	.5716	.0891	.1558	.3558	3170.4	1639.7	54985.7
39.0	222.2	.2000	.6062	.0957	.1578	.3578	2586.9	1409.9	51005.1
40.0	227.1	.2000	.6454	.1237	.1916	.3916	2082.4	1187.6	46263.2
41.0	182.0	.2000	.6899	.1285	.1862	.3862	1617.3	979.5	41016.1
42.0	99.1	.2000	.7411	.0900	.1215	.3215	1239.0	817.0	36708.6
43.0	95.0	.2000	.8004	.1114	.1392	.3392	976.3	684.4	32940.6
44.0	74.4	.2000	.8701	.1154	.1327	.3327	744.2	562.2	28944.7
45.0	76.8	.2000	.9531	.1646	.1726	.3726	557.1	447.0	24574.5
46.0	42.4	.2000	1.0536	.1287	.1221	.3221	390.6	349.0	20462.0
47.0	46.9	.2000	1.1778	.2103	.1786	.3786	278.2	264.3	16507.8
48.0	25.6	.2000	1.3353	.1792	.1342	.3342	178.1	191.8	12742.2
49.0	34.2	.2000	1.5415	.4303	.2792	.4792	114.0	124.2	8765.4
50.0	8.9	.2000	1.8232	.2174	.1193	.3193	54.5	75.3	5634.7
51.0	18.3	.2000			.3000	.5000	30.4	.0	.0
				TOTAL BIOMASS INCLUDES LENGTHS ABOVE		+GP	716307.4	4007562.0	

Table 5.11.14 Irish Sea West (FU15): Males - VPA tuning information

```
Age  3

Fleet    F       var(F)      wt     slope          int       N

 NI MA  .7240   .1841E-01   .8144   .0000E+00 -.1307E+02    8
  R  M Not used
Hist F  .6081   .8079E-01   .1856 -.5194E-01 -.3833E+00    8

Tuned F= .7009

Age  4

Fleet    F       var(F)      wt     slope          int       N

 NI MA 1.0828   .1343E-01   .5694   .0000E+00 -.1274E+02    8
  R  M Not used
Hist F  .8758   .1776E-01   .4306 -.6962E-01  .2039E-01    8

Tuned F= .9883

Age  5

Fleet    F       var(F)      wt     slope          int       N

 NI MA 1.0614   .4460E-01   .5165   .0000E+00 -.1281E+02    8
  R  M Not used
Hist F  .8122   .4765E-01   .4835 -.1659E+00  .1565E+00    8

Tuned F= .9326

Age  6

Fleet    F       var(F)      wt     slope          int       N

 NI MA  .6980   .4850E-01   .7374   .0000E+00 -.1294E+02    8
  R  M Not used
Hist F  .7285   .1362E+00   .2626 -.2006E+00  .1240E+00    8

Tuned F= .7059

Age  7

Fleet    F       var(F)      wt     slope          int       N

 NI MA  .7425   .2525E+00   .5435   .0000E+00 -.1310E+02    8
  R  M Not used
Hist F  .5798   .3006E+00   .4565 -.5351E+00  .6307E+00    8

Tuned F= .6632

Age  8

Fleet    F       var(F)      wt     slope          int       N

 NI MA  .7668   .6013E+00   .6749   .0000E+00 -.1303E+02    8
  R  M Not used
Hist F  .8130   .1248E+01   .3251 -.1381E+00  .9635E-01    8

Tuned F= .7816
```

Table 5.11.15 Irish Sea West (FU15): Females - VPA tuning information

Age 3

Fleet	F	var(F)	wt	slope	int	N
NI FE	.5057	.2654E-01	.7155	.0000E+00	-.1304E+02	8
RO FE	Not used					
Hist F	.6157	.6675E-01	.2845	-.8423E-01	-.2998E+00	8

Tuned F= .5348

Age 4

Fleet	F	var(F)	wt	slope	int	N
NI FE	.6380	.6548E-01	.5828	.0000E+00	-.1284E+02	8
RO FE	Not used					
Hist F	.7911	.9149E-01	.4172	.4072E-01	-.3238E+00	8

Tuned F= .6979

Age 5

Fleet	F	var(F)	wt	slope	int	N
NI FE	.5698	.7445E-01	.6857	.0000E+00	-.1292E+02	8
RO FE	Not used					
Hist F	.6523	.1624E+00	.3143	-.1046E+00	-.1975E+00	8

Tuned F= .5945

Age 6

Fleet	F	var(F)	wt	slope	int	N
NI FE	.3839	.2330E+00	.5621	.0000E+00	-.1322E+02	8
RO FE	Not used					
Hist F	.5020	.2991E+00	.4379	-.2633E+00	-.1106E+00	8

Tuned F= .4317

Age 7

Fleet	F	var(F)	wt	slope	int	N
NI FE	.2776	.6235E+00	.2378	.0000E+00	-.1354E+02	8
RO FE	Not used					
Hist F	.4491	.1946E+00	.7622	-.2731E+00	-.2004E+00	8

Tuned F= .4005

Age 8

Fleet	F	var(F)	wt	slope	int	N
NI FE	.2194	.4533E+00	.8569	.0000E+00	-.1374E+02	8
RO FE	Not used					
Hist F	.3278	.2714E+01	.1431	-.5379E+00	.6646E-01	8

Tuned F= .2323

Table 5.11.16 Irish Sea West (FU15): Males - VPA input and output

Age	M	Prop. Mature
1	.30	1.00
2	.30	1.00
3	.30	1.00
4	.30	1.00
5	.30	1.00
6	.30	1.00
7	.30	1.00
8	.30	1.00
9	.30	1.00
10	.30	1.00

Catch-at age data

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	2537.	4395.	573.	1842.	3535.	2165.	1463.	2497.	2045.
2	108654.	112311.	60333.	84985.	85704.	103420.	60204.	120780.	141485.
3	250484.	266555.	158965.	203165.	191229.	238005.	166524.	206954.	288028.
4	105457.	119680.	93540.	89431.	110659.	116151.	95720.	89498.	111729.
5	31224.	37434.	36001.	24776.	28121.	34237.	28168.	25492.	32043.
6	10297.	12994.	11309.	7182.	6982.	8334.	9099.	7219.	8448.
7	3430.	4095.	4511.	3599.	2284.	2071.	1781.	2079.	3391.
8	1515.	1340.	1711.	484.	785.	747.	1294.	580.	1030.
9	532.	548.	688.	319.	97.	420.	285.	62.	397.
10	576.	1719.	898.	376.	238.	95.	199.	51.	397.

Weight-at-age dat

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.0030	.0020	.0030	.0020	.0020	.0020	.0020	.0030	.0020
2	.0060	.0060	.0060	.0060	.0060	.0060	.0060	.0060	.0060
3	.0110	.0110	.0120	.0110	.0120	.0110	.0110	.0110	.0110
4	.0190	.0190	.0190	.0190	.0190	.0190	.0190	.0190	.0190
5	.0290	.0290	.0290	.0290	.0280	.0280	.0280	.0290	.0280
6	.0390	.0390	.0390	.0390	.0390	.0390	.0390	.0390	.0390
7	.0510	.0500	.0510	.0500	.0500	.0510	.0500	.0500	.0500
8	.0620	.0610	.0620	.0620	.0610	.0610	.0600	.0600	.0610
9	.0720	.0720	.0710	.0720	.0710	.0710	.0720	.0710	.0740
10	.0920	.1030	.0920	.0880	.0880	.1010	.0880	.0790	.0910

F-at-age

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.0032	.0049	.0006	.0020	.0043	.0025	.0012	.0034	.3000
2	.1611	.2080	.0957	.1355	.1327	.1844	.0967	.1473	.3000
3	.6818	.8426	.5758	.5990	.5730	.7423	.5724	.6254	.7009
4	.8017	.9831	.9791	.8841	.9127	.9888	.9046	.8147	.9883
5	.7630	.8865	1.1298	.9046	.9227	.9724	.8095	.7564	.9326
6	.7144	1.0194	.8722	.8393	.8223	.9323	.8941	.5690	.7059
7	.6793	.8176	1.7017	.9099	.8314	.7176	.5941	.5959	.6632
8	.7781	.7179	1.2268	1.0745	.5808	.8493	1.9700	.4436	.7816
9	.7239	.8516	1.2669	.9412	.7448	.8331	1.1527	.5361	.7169
10	.7239	.8516	1.2669	.9412	.7448	.8331	1.1527	.5361	.7169

N-at-age

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	932561.	1036059.	1044679.	1076263.	959462.	1020770.	1374683.	849485.	9064.
2	841754.	688675.	763748.	773424.	795730.	707744.	754341.	1017131.	627165.
3	576805.	530788.	414371.	514187.	500337.	516242.	436032.	507329.	650319.
4	217037.	216099.	169323.	172590.	209266.	208988.	182048.	182235.	201097.
5	66454.	72120.	59898.	47122.	52814.	62234.	57598.	54583.	59778.
6	22939.	22954.	22018.	14337.	14128.	15550.	17435.	18991.	18979.
7	7919.	8318.	6135.	6819.	4589.	4599.	4535.	5283.	7964.
8	3182.	2974.	2720.	829.	2034.	1480.	1662.	1854.	2157.
9	1175.	1083.	1075.	591.	210.	843.	469.	172.	882.
10	1271.	3398.	1404.	697.	515.	190.	327.	139.	881.

Year	Yield	Fbar 3- 5	TSB	SSB	Log R
1986	7085.8	.7488	21941.3	21941.3	13.75
1987	7984.0	.9040	20160.7	20160.7	13.85
1988	6001.2	.8949	19188.9	19188.9	13.86
1989	5712.2	.7959	18150.3	18150.3	13.89
1990	6168.1	.8028	19116.9	19116.9	13.77
1991	6924.0	.9012	18690.4	18690.4	13.84
1992	5362.9	.7622	18212.4	18212.4	14.13
1993	5877.2	.7321	20416.4	20416.4	13.65
1994	7668.6	.8739	17844.6	17844.6	9.11

Table 5.11.17 Irish Sea West (FU15): Females - VPA input and output

Age	M	Prop. Mature
1	.30	.00
2	.30	.00
3	.20	1.00
4	.20	1.00
5	.20	1.00
6	.20	1.00
7	.20	1.00
8	.20	1.00
9	.20	1.00
10	.20	1.00
11	.20	1.00
12	.20	1.00

Catch-at age data

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	10442.	11437.	7164.	7102.	7199.	10807.	8565.	9134.	5352.
2	221451.	185021.	125397.	156404.	154880.	202177.	114702.	196813.	169239.
3	145076.	167775.	126966.	128344.	132318.	138594.	127562.	146858.	131558.
4	58490.	64193.	62440.	67735.	57472.	49014.	83885.	80841.	57697.
5	23412.	23781.	23149.	26069.	21373.	15576.	29259.	23050.	21470.
6	9269.	10271.	8405.	9857.	7409.	6305.	8799.	5956.	8585.
7	3747.	3819.	3729.	3796.	3039.	2818.	3755.	2223.	2940.
8	1388.	2306.	2048.	1482.	897.	1590.	1961.	629.	766.
9	876.	770.	1397.	781.	457.	435.	539.	193.	538.
10	467.	660.	573.	228.	271.	308.	166.	93.	261.
11	603.	145.	221.	100.	179.	239.	130.	160.	55.
12	755.	123.	640.	409.	7.	1204.	518.	472.	162.

Weight-at-age dat

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.0030	.0030	.0030	.0030	.0020	.0030	.0020	.0030	.0030
2	.0060	.0060	.0060	.0060	.0060	.0060	.0060	.0060	.0060
3	.0090	.0090	.0100	.0100	.0090	.0090	.0100	.0100	.0090
4	.0130	.0130	.0130	.0130	.0130	.0130	.0130	.0130	.0130
5	.0170	.0170	.0170	.0170	.0170	.0170	.0170	.0170	.0170
6	.0210	.0220	.0210	.0210	.0220	.0210	.0220	.0210	.0210
7	.0260	.0260	.0260	.0260	.0260	.0260	.0260	.0260	.0260
8	.0300	.0310	.0300	.0300	.0300	.0300	.0300	.0300	.0300
9	.0350	.0350	.0350	.0350	.0350	.0350	.0360	.0360	.0360
10	.0400	.0390	.0390	.0390	.0400	.0390	.0400	.0400	.0390
11	.0440	.0420	.0430	.0440	.0430	.0440	.0440	.0440	.0430
12	.0460	.0000	.0480	.0480	.0450	.0480	.0480	.0480	.0490

F-at-age

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.0145	.0188	.0107	.0093	.0092	.0166	.0105	.0104	.3000
2	.4368	.4233	.3270	.3762	.3199	.4239	.2715	.3928	.3000
3	.6917	.7617	.6263	.7085	.6858	.5682	.5606	.7162	.5348
4	.7098	.7728	.7326	.8333	.8274	.5915	.8285	.8652	.6979
5	.6845	.7199	.7214	.7996	.6981	.5587	.8805	.5704	.5945
6	.5961	.7468	.6087	.7969	.5565	.4547	.7237	.4363	.4317
7	.4449	.5287	.6789	.6204	.6167	.4257	.5416	.3996	.4005
8	.4757	.5457	.6085	.6388	.2870	.7842	.5975	.1601	.2323
9	.4860	.5316	.7664	.4956	.4120	.2195	.6816	.1043	.2000
10	.8118	.8502	1.0029	.2631	.3183	.5423	.1219	.2326	.2000
11	.5912	.6425	.7926	.4658	.3391	.5154	.4670	.1657	.2108
12	.5912	.6425	.7926	.4658	.3391	.5154	.4670	.1657	.2108

N-at-age

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	841077.	710064.	780459.	885140.	913091.	761190.	947370.	1023262.	23722.
2	716502.	614098.	516185.	572012.	649615.	670238.	554602.	694457.	750190.
3	316974.	342925.	297918.	275735.	290875.	349481.	324951.	313160.	347320.
4	125510.	129931.	131068.	130388.	111143.	119948.	162092.	151868.	125268.
5	51535.	50529.	49113.	51572.	46396.	39780.	54355.	57957.	52340.
6	22552.	21279.	20137.	19543.	18978.	18897.	18627.	18450.	26823.
7	11428.	10172.	8255.	8969.	7211.	8906.	9818.	7395.	9764.
8	4015.	5996.	4908.	3428.	3949.	3186.	4764.	4677.	4060.
9	2490.	2043.	2844.	2187.	1481.	2426.	1191.	2146.	3263.
10	915.	1254.	983.	1082.	1091.	803.	1595.	493.	1583.
11	1476.	333.	439.	295.	681.	650.	382.	1156.	320.
12	1847.	283.	1273.	1201.	28.	3270.	1521.	3399.	935.

Year	Yield	Fbar3- 5	TSB	SSB	Log R
1986	4275.8	.6953	13347.6	6525.3	13.64
1987	4356.8	.7515	12502.1	6687.3	13.47
1988	3710.1	.6934	11959.1	6520.6	13.57
1989	3983.1	.7805	12352.4	6264.9	13.69
1990	3548.7	.7371	11424.8	5701.0	13.72
1991	3753.1	.5728	12711.7	6406.7	13.54
1992	3976.5	.7565	12507.6	7285.2	13.76
1993	4367.2	.7173	14358.7	7122.2	13.84
1994	3652.9	.6091	11394.2	6821.9	10.07

Table 5.11.18 Nephrops landings (tonnes) by Functional Unit plus other rectangles in Management Area J (VIIa excluding rectangles 33E2-E5)

Year	FU 14	FU 15	Other	Total
1985	541	6443		6984
1986	728	8882		9610
1987	534	9331		9865
1988	516	8630		9146
1989	438	8084		8522
1990	644	8278	<1	8922
1991	859	9468		10372
1992	495	7502	2	7999
1993	618	8111		8729
1994	515	7322		7837

Table 5.11.19 Total Nephrops landings (tonnes) by country in Management Area J (VII a excluding rectangles 33E2-E5)

Year	UK	Isle of Man	Republic of Ireland	France	Belgium	Total
1985	4913	3	2026	42	0	6984
1986	5929	7	3581	93	<1	9610
1987	5514	18	4278	55	0	9865
1988	5780	39	2965	62	0	9146
1989	6011	8	2484	19	0	8522
1990	6165	25	2724	8	0	8922
1991	6864	61	3390	12	<1	10372
1992	5596	14	2381	6	<1	7999
1993	5939	32	2750	8	0	8729
1994	6147	16	1673	1	0	7837

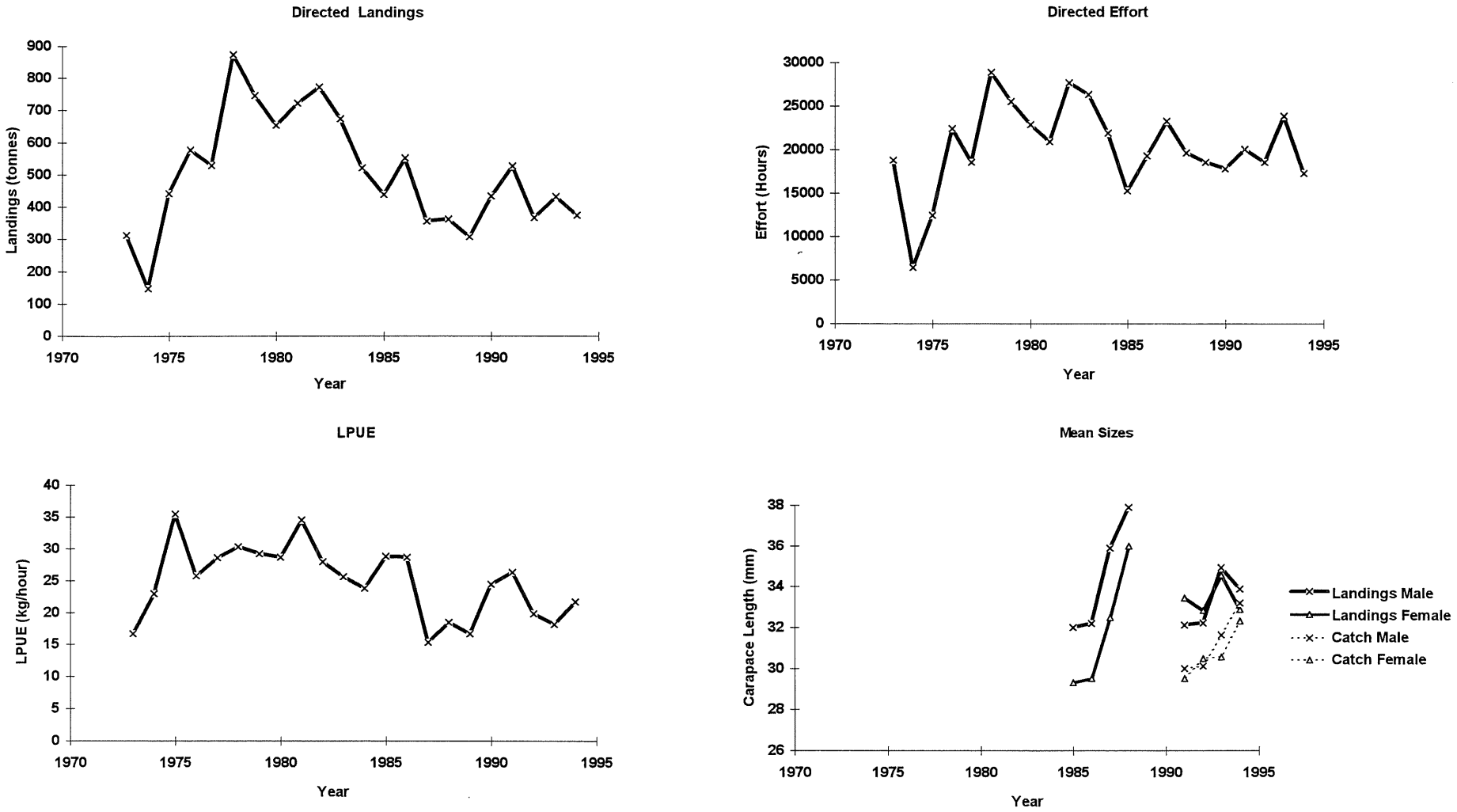


Figure 5.11.1 Irish Sea East (FU14): Long term trends in directed landings (tonnes), directed effort (hours), LPUE (kg/hour) and mean sizes (mm CL) in the landings and catch

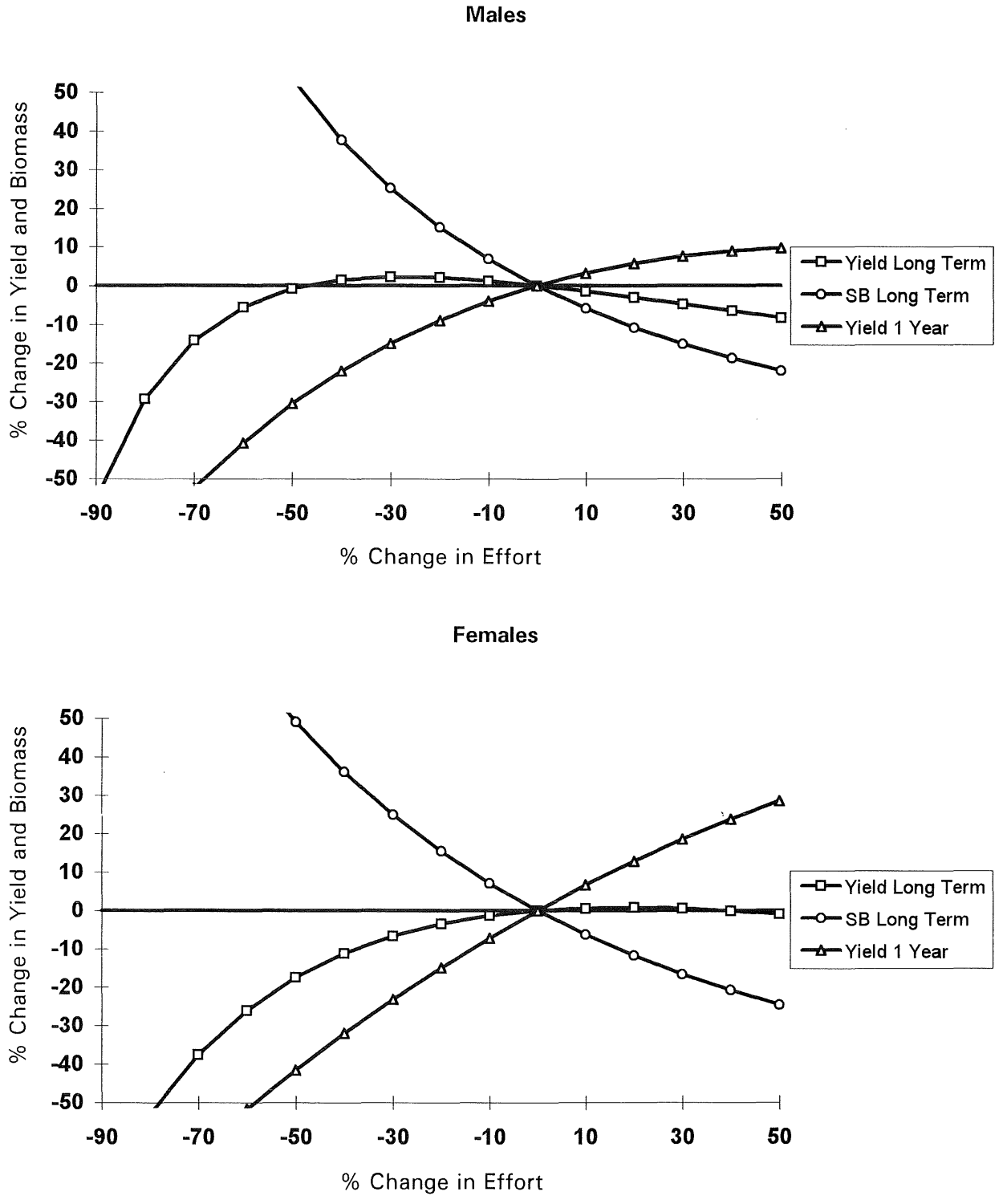
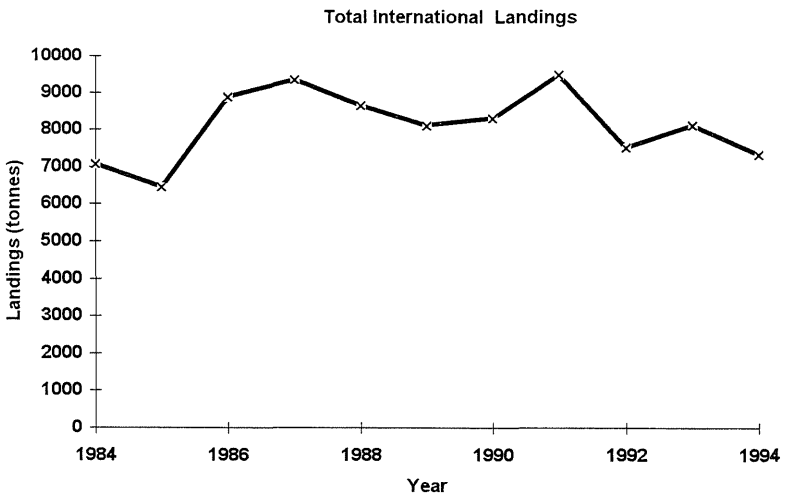
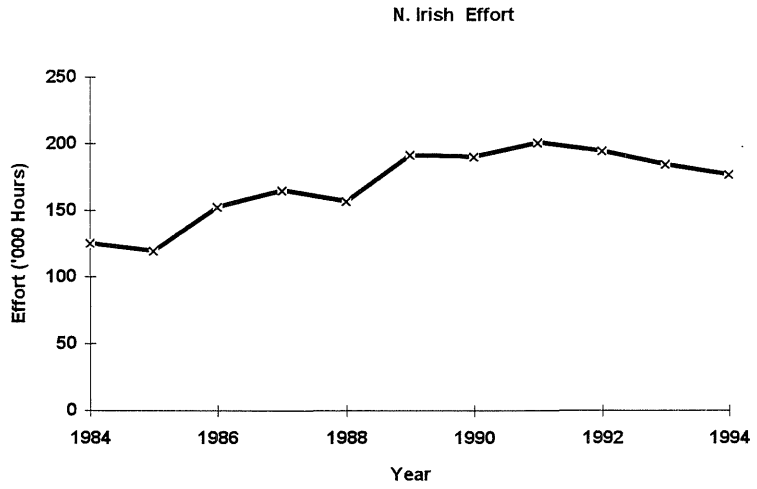
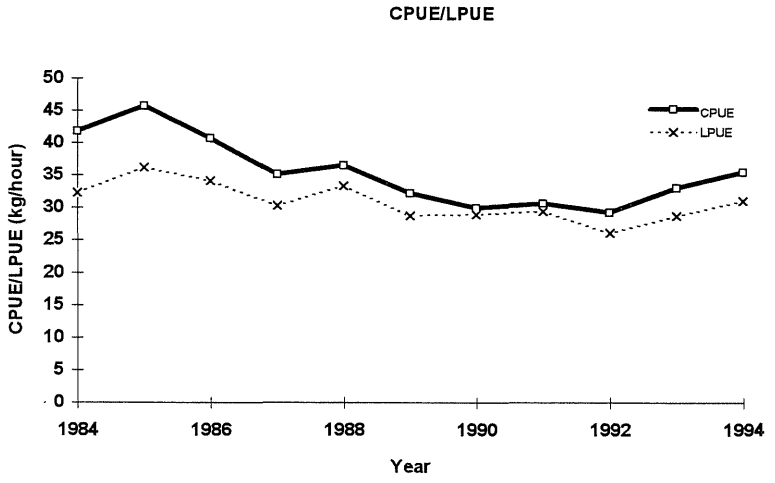


Figure 5.11.2 Irish Sea East (FU14): Percentage changes in long term landings and stock biomass, and short term landings following various changes in fishing effort. Males and females shown separately







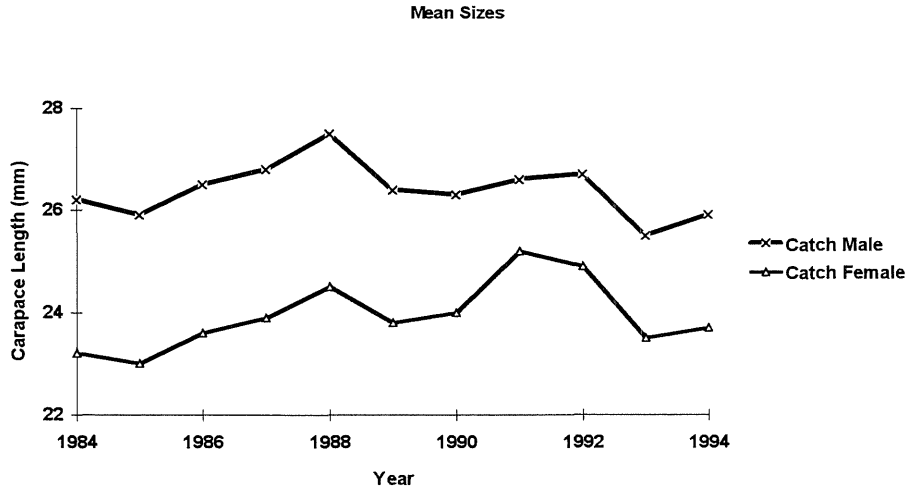


Figure 5.11.3 Irish Sea West (FU15): Long term trends in total international landings (tonnes) and N. Irish effort ('000 hours), CPUE and LPUE (kg/hour) and mean sizes (mm CL) in the catch

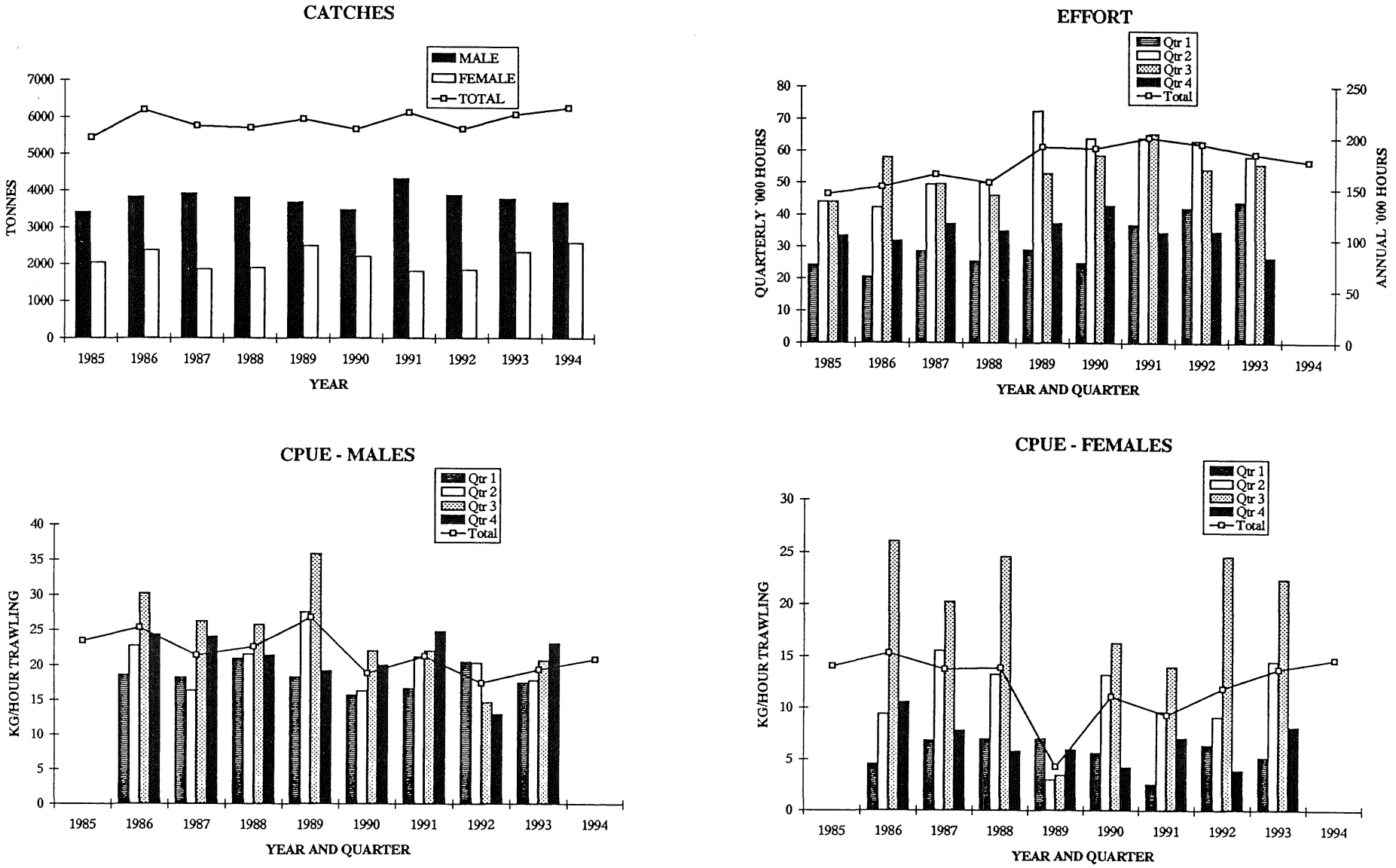


Figure 5.11.4. Irish Sea West (functional unit 15) : trends in landings,effort and CPUE by quarter and sex from Northern Ireland Nephrops trawlers.

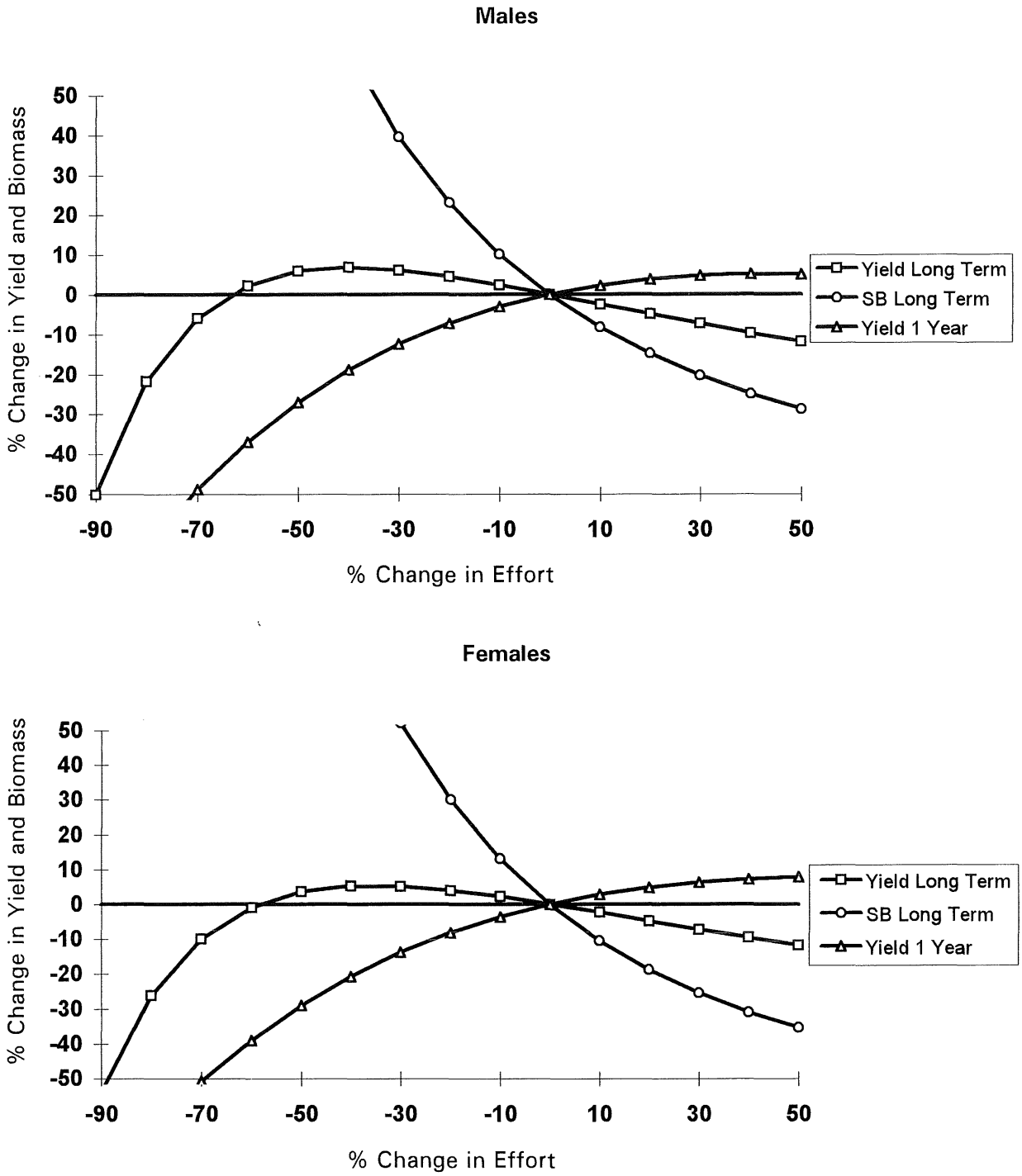
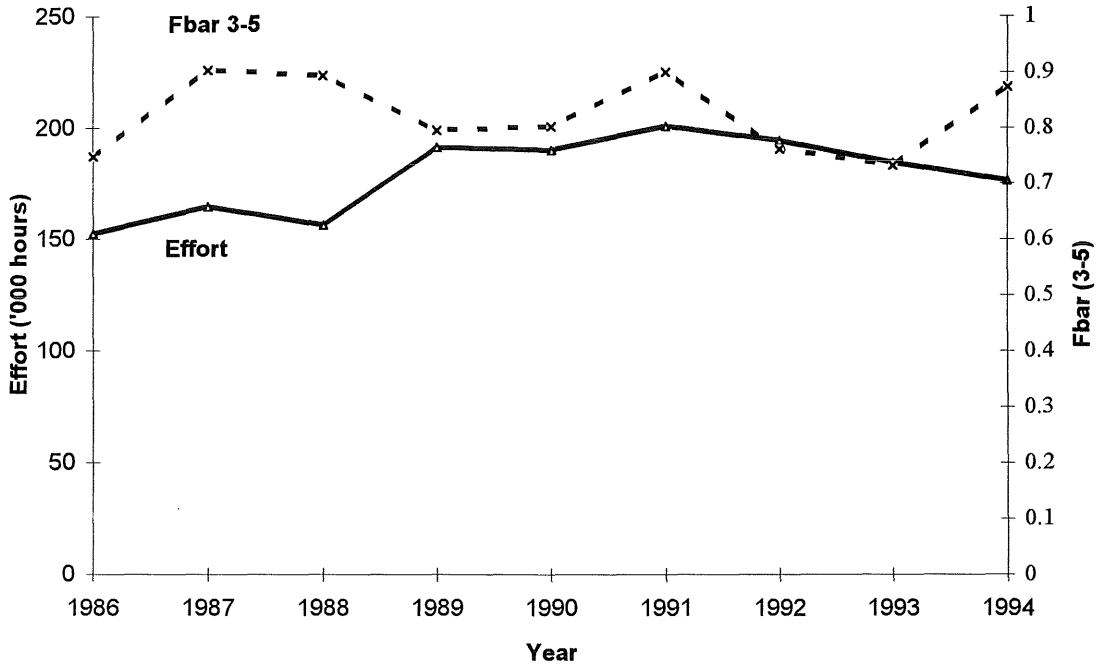


Figure 5.11.5 Irish Sea West (FU15): Percentage changes in long term landings and stock biomass, and short term landings following various changes in fishing effort. Males and females shown separately



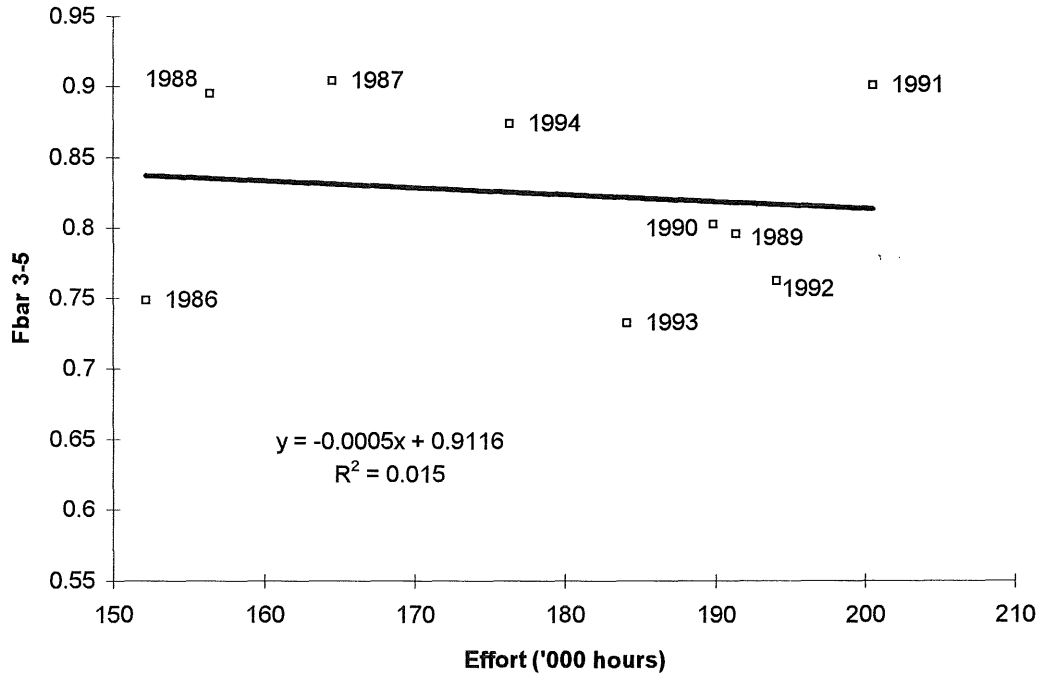


Figure 5.11.6 Irish Sea West (FU15): Males - plot of effort and Fbar from NEPASS, together with their regression.

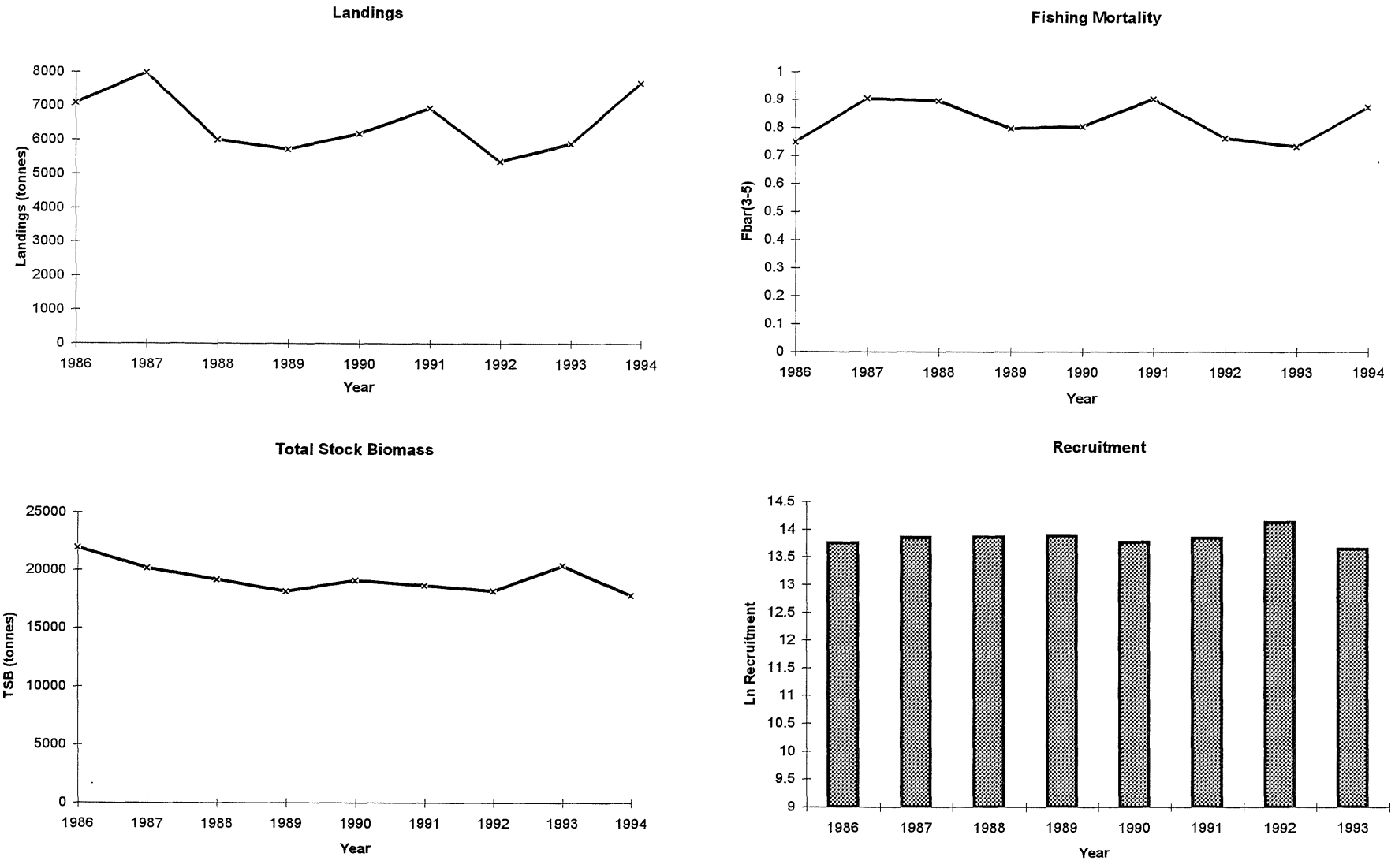
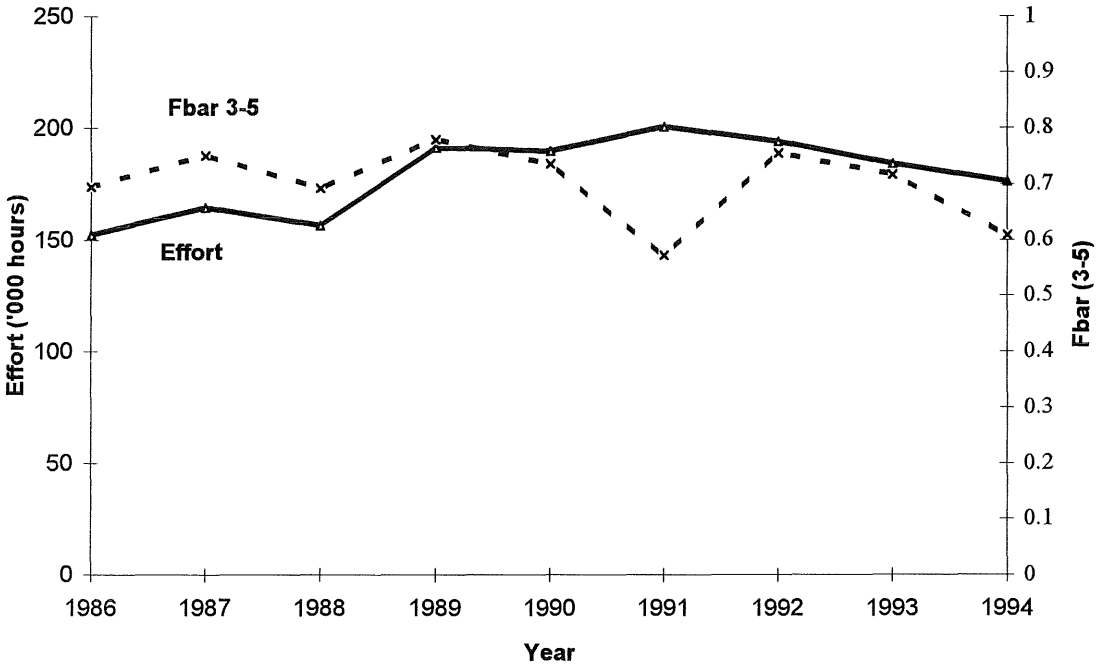


Figure 5.11.7 Irish Sea West (FU15): Males - trends in landings, fishing mortality, total stock biomass, and Ln recruitment from NEPASS.



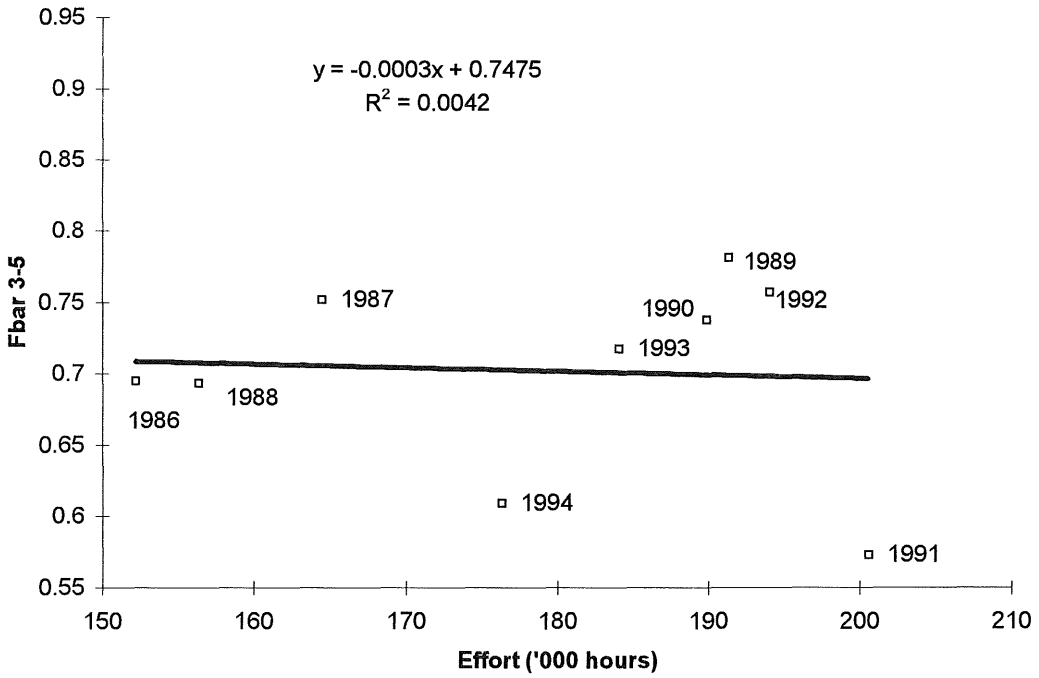


Figure 5.11.8 Irish Sea West (FU15): Females - plot of effort and Fbar from NEPASS, together with their regression.

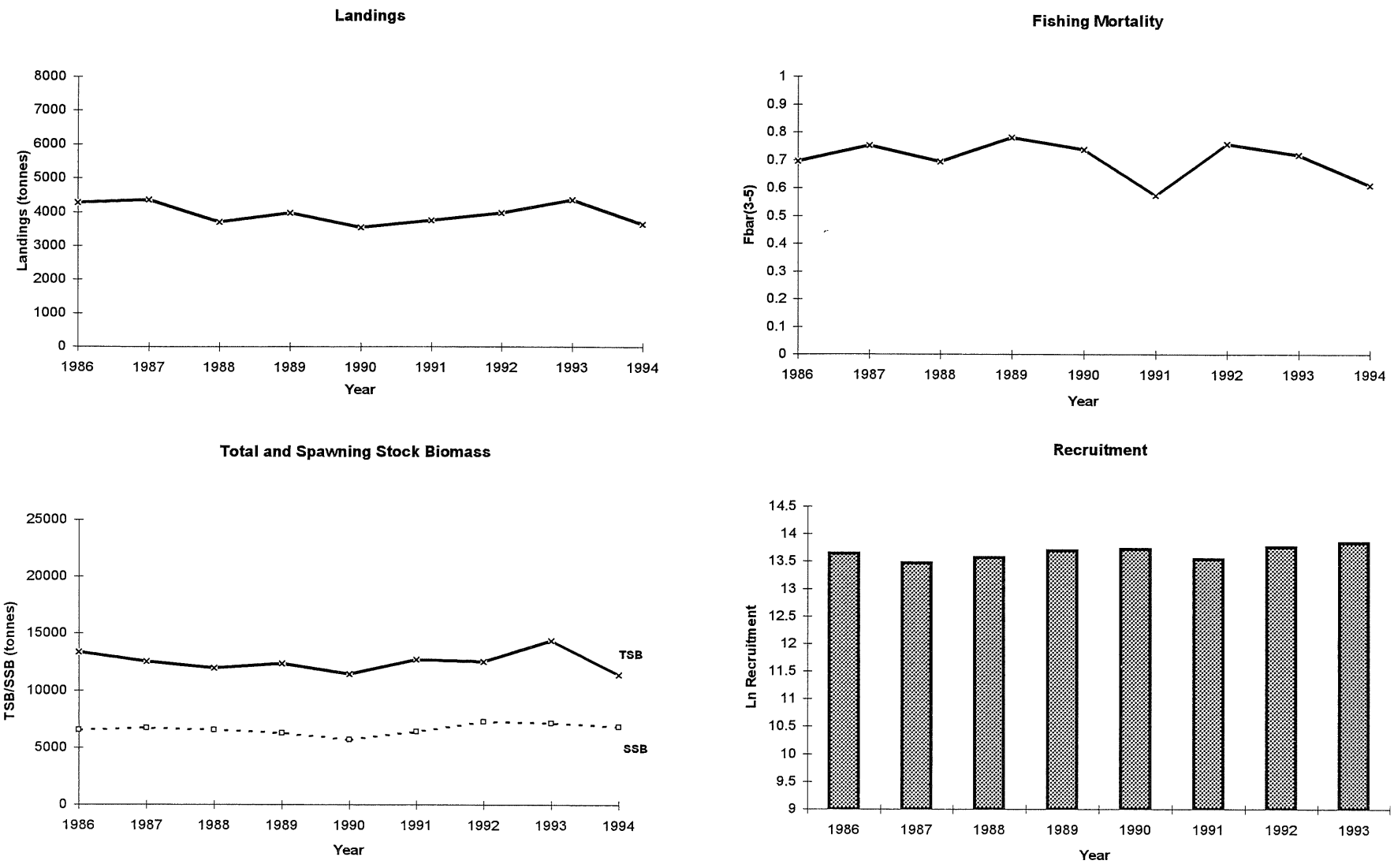


Figure 5.11.9 Irish Sea West (FU15): Females - trends in landings, fishing mortality, total stock biomass, and Ln recruitment from NEPASS.

5.12. Division VIId,e (Management Area K)

Functional Units - none

5.12.1. Summary of Division VIId,e (Management Area K)

Zero TAC to prevent misreporting.

5.13. Divisions VIIb, c, j, k (Management Area L)

Functional Units	Porcupine Bank	(16)
	Aran Grounds	(17)
	NW and W Ireland	(18)
	SW Ireland	(19)

The statistical rectangles comprising this Management Area and its constituent Functional Units are shown in Figure 5.1.2.

5.13.1. Porcupine Bank (Functional Unit 16)

Data and biological inputs

Landings and effort data were available for 1994. Length compositions of the landings were available for Spain only. There were no new biological inputs (Table 5.13.1).

Fleets of four countries (Spain, France, UK and Ireland) are involved in the *Nephrops* fishery on Porcupine Bank, but a long-time series of length compositions is available for Spain only (1980-1994). Length compositions from the Irish landings are only available for 1989-1991.

Comments on general quality of inputs

Length composition data are collected on a monthly basis at La Coruña (NW Spain) by a routine port sampling programme (Table 5.13.1). In 1994, 3 samples were taken per month, with on average 357 individuals per sample. In addition, at the port of Vigo, 1 sample per month was taken (on average 119 individuals) from the landings allocated to the other rectangles in Management Area L.

The 1991 length composition of the Irish landings differs significantly from Spanish data, suggesting that the Irish fleet, which is composed of vessels with a smaller tonnage operates on another part of the stock nearer to the coast.

The lack of French sampling data is due to the seasonal characteritics of the fishery for this fleet, combined with the fact that vessels often fish the Porcupine Bank and Celtic Sea in the same trip and catches from the two grounds are indistinguishable. Sampling effort has been directed to the catches made in the Celtic Sea which are more important to the French fleet.

Landings, effort, CPUE and LPUE

Landings were reported by Spain, France, UK and Ireland.

Spain

Landings by Spanish vessels from the Porcupine Bank were 809t in 1994, slightly above the lowest ever recorded in 1993 (Table 5.13.2, long-term trends Figure 5.13.1). After having slightly increased in 1987, the landings have shown a gradual decline from 1987 to 1993. The decrease in fishing effort (see below) is probably the main reason for the recent drop in landings.

Total Spanish trawl fishing effort has declined since 1989 (Table 5.13.3, long term trends Figure 5.13.1). In 1994 it was at the same low level as in 1993, at less than half the 1989 level. This reduction in fishing effort is mainly related to the reduction in the size of the Spanish fleet.

The CPUE of trawlers directed to *Nephrops* (i.e. vessels where the ratio of *Nephrops*/hake by weight in the total annual landings is >1) fell almost continuously from 1985 to 1991, but has increased again in the last three years (Table 5.13.3, long term trends Figure 5.13.1). The CPUE of the trawlers directed to hake, which take *Nephrops* as a bycatch, declined in 1986 and has since remained fairly stable, albeit with small fluctuations. The overall CPUE of the trawler fleet showed a similar pattern (Table 5.13.3), with a small increase in 1994.

France

The exploitation of the *Nephrops* stock in the Porcupine Bank area by French vessels started in 1981-1982. This fishery is clearly seasonal, with most fishing taking place during the summer months. For the period 1984-1986 it yielded fairly large catches (around 1000t a year) but fell in the following five years to about 300t (Table 5.13.2). The landings have increased again in 1993-1994 to well over 800t. The French LPUE data tend to follow the trends in their landings (Table 5.13.3).

Republic of Ireland

Landings in 1993 were revised upwards from 36t to 206t, and increased slightly in 1994 to 233t (Table 5.13.2). The increased landings were partly due to improved statistics. The area of origin of landings at several ports, not primarily associated with the Porcupine Bank fishery, have been recorded in detail, showing that there was some effort by Ireland in this area.

UK

Landings of English vessels landing in Spain and Ireland from Porcupine bank were 71 tonnes in 1994, less than a half of the second highest landings in 1992 (Table 5.13.2).

Mean size

There were no mean size data from the Republic of Ireland, France or the UK.

Spain

The mean size of the catches of males fluctuated without trend over the period 1985-1994, with values ranging between 38.7mm and 41.7 mm CL (Table 5.13.4 and

Figure 5.13.1). The mean size of females showed larger fluctuations (33.5 to 38.4mm CL), but without an obvious trend.

Mean sizes of male and female *Nephrops* in the landings of trawlers from Vigo are given in Table 5.13.4 for the period 1985-1994. Mean sizes increases for both sexes, especially females, in 1994. They have fluctuated around 37 mm CL for males, and 31 mm CL for females in earlier years, except in 1990 when the lowest value for both sexes was recorded. Landings of this fleet are mostly allocated to other rectangles (ICES statistical rectangles 27-29 D6) of Management Area L.

Assessments

No new information on biological parameters was available. The lack of information on discard practices and length compositions for the French, UK and Irish landings could cause some uncertainty in the analysis, and therefore the assessments (LCA and VPA) performed in 1993 (Anon., 1993) were not repeated.

Management considerations

The results of previous length based assessments gave flat-topped Y/R curves and suggest that the long-term gains from an effort reduction would be small.

The decrease in landings and fishing effort, together with an increase in CPUE in recent years, suggest this FU does not give cause for concern. The current landings for FU 16, combined with FU 17 to 19, are well below the current TAC of 4000 t. There is no basis for revising this figures for 1996.

5.13.2. Aran Grounds (Functional Unit 17)

Data and Input parameters

As there has been no sampling of this stock since 1991 (Table 5.13.5), only landings data are available. In view of the size of this fishery, this situation is very regrettable.

Landings

Over 90% of landings form this area are made by the Republic of Ireland fleet, with very small amounts from France and the UK (Table 5.13.6). The downward trend in landings has continued with a fall from nearly 2000t in 1985 to under 200t last year. While the 1993 landings at 369t were slightly below those for 1992, the preliminary figure reported for 1994 was 192t, a further decrease of 50%.

Assessments

It is not possible to carry out realistic assessments due to a lack of data.

Management Considerations

In the absence of effort data and a proper assessment, the only bases for catch options are the average of recent landings or extrapolation of any existing trend. It is difficult to know whether the poor 1994 value was due to exceptional factors lowering effort, or whether it is mainly due to past overfishing. In the absence of any assessment or effort data there is no reason to change the management advice given last year.

5.13.3. Republic of Ireland coast (NW, W and SW) (Functional Units 18 and 19)

Data and input parameters

There has been no sampling of length composition and there are no input parameter values available. Since the amount landed in Functional Unit 19 is considerable, this deficiency is extremely regrettable.

Landings

Landings for Functional Unit 18 remain negligible (Table 5.13.7). Those for FU 19 are almost completely by Republic of Ireland boats with an extremely small UK component (Table 5.13.7). 1993 landings were revised slightly upwards to 675t as a result of an increase in information regarding the area of their origin, but preliminary 1994 landings are markedly down at 350t, the lowest in the last ten years.

Management Considerations

In the absence of any assessment or effort data there is no reason to change the management advice given last year.

5.13.4. Summary of Division VIIb,c,j,k (Management Area L)

Other rectangles

The catch in 1993 for rectangles other than those in FU's 16, 17, 18 and 19 in Management Area L, amounted to 425 t, close to the preceding year's landings, which were the highest in the ten year series (Table 5.13.8). Landings for 1994 were lower, at 376 t, and were almost 70% Spanish, 30% UK and <1% Belgian. The total landings for Management Area L at 2892 t in 1994 were the lowest of the last ten years (Table 5.13.9).

The management advice given in 1994 remains unchanged.

Table 5.13.1 Data and Input Parameters: Porcupine Bank

FU	16	MA	L (VII b,c,j,k)
FLEET	Spain	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch					
Landings	9	9	9	9	357
Discards					

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch										
Landings	36	37	36	36	36	35	29	20	21	19
Discards										

FLEET	Rep.Ireland	GEAR	Trawl

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch										
Landings	0	0	10	16	35	0	0	0	0	0
Discards										

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	-	Discards considered negligible <2%
MALES		
Growth - K	0.14	based on values in other areas (Anon. 1991)
Growth - L(inf)	75	based on maximum sizes observed in samples
Nat. Mort. - M	0.2	Anon.1990 (estimated)
Length/weight - a	0.00009	based on Celtic Sea (FU 20-22)
Length/weight - b	3.55	"
FEMALES		
Immature Growth		Not applicable - few below CL50 mat.
K		
L(inf)		
Nat.Mort. - M		
Size at Maturity	24	Spanish observations from sampling
Mature Growth		
K	0.16	Anon.1991
L(inf)	60	based on maximum sizes observed
Nat.Mort. - M	0.2	As for males
Length/weight - a	0.00009	"
Length/weight - b	3.55	"

Table 5.13.2 Porcupine Bank (Functional Unit 16): Landings (tonnes) by country, 1985-94

Year	France	Spain	UK	Ireland a	Total
1985	1181	2738	34	?	3953
1986	1060	1462	47	?	2569
1987	609	1677	153	?	2439
1988	600	1555	174	?	2329
1989	324	1417	17	350	2108
1990	336	1349	29	169	1883
1991	348	1021	74	170	1613
1992	665	822	170	311	1968
1993	868	752	69	206	1895
1994*	861	809	71	233	1974

* Provisional a) Prior to 1989 Irish landings not distinguished from those of Aran Islands

Table 5.13.3 Porcupine Bank (Functional Unit 16): Total effort (all gears combined) and CPUE (kg/day*BHP/100) for two components of Spanish fleet and combined. Also, effort (hours fishing) and LPUE (kg/hour) of French Nephrops trawlers from St Guénolé. All 1985-94

Year	Spanish Trawl fleet, effort and CPUE				French fleet	
	Total eff	Nephrops	Finfish	Total	Effort	LPUE
1985	115331	74.6	18.5	23.7	43577	34.5
1986	95269	61.8	10.9	15.4	34766	36.6
1987	104530	60.8	12.7	16.0	29877	24.7
1988	108856	43.8	10.8	14.3	21279	25.8
1989	104825	45.1	10.8	13.5	16126	21.5
1990	96299	35.5	11.5	14.0	19100	19.9
1991	85220	33.4	8.9	12.0	23830	16.1
1992	58516	40.2	11.0	14.0	34989	19
1993	50007	39.9	9.9	15.1	41082	21
1994	49997	45.6	11.1	16.2	29052	30

Table 5.13.4 Porcupine Bank (Functional Unit 16): Mean sizes (CL mm) of male and female Nephrops in Spanish catches, 1985-94. Mean sizes '(b)' of Nephrops caught in 'other' rectangles of VIIb, c, j,k and measured as landings at home port of Vigo.

Year	Males	Females	Males(b)	Females(b)
1985	38.7	33.5	36.4	32.2
1986	40.8	34.9	37.0	32.6
1987	39.5	35.1	34.5	30.4
1988	40.7	38.4	40.3	34.0
1989	40.5	36.5	37.4	30.9
1990	41.0	36.8	31.6	26.3
1991	39.4	34.5	37.1	34.7
1992	39.1	34.2	36.7	31.5
1993	41.7	36.1	39.1	35.9
1994	40.7	36.6	40.8	39.3

Table 5.13.5 Data and input parameters: Aran Grounds (Galway Bay)

FU	17	MA L	(VIIb,c,j,k)
FLEET	Ireland	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch					
Landings					
Discards					

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch										
Landings	0	0	0	20	24	0	0	0	0	0
Discards										

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival		Not applicable, discards neglibible
MALES		
Growth - K	0.15	based on FUs 15 and 16
Growth - L(inf)	60	based on FU 15
Nat. Mort. - M	0.3	assumed, in line with other stocks
Length/weight - a	.00032	based on Scottish data (Pope and Thomas, 1955)
Length/weight - b	3.21	"
FEMALES		
Immature Growth		
K	0.15	as for males
L(inf)	60	"
Nat.Mort. - M	0.3	"
Size at Maturity	24	
Mature Growth		
K	0.1	"
L(inf)	50	
Nat.Mort. - M	0.2	
Length/weight - a	0.00068	as for males
Length/weight - b	2.96	"

* No sampling from 1992 to 1994

Table 5.13.6 Aran Grounds (Functional Unit 17): Landings (tonnes) by country, 1985-94

Year	France	Ireland a	UK	Total
1985	324	1665	0	1989
1986	207	838	0	1045
1987	147	1030	0	1177
1988	62	691	0	753
1989	14	814	0	828
1990	27	317	1	345
1991	30	489	0	519
1992	11	399	2	412
1993	8	361	0	369
1994*	7	181	4	192

* provisional a) Prior to 1989 landings represent Aran + Porcupine.

Table 5.13.7 Republic of Ireland coast (Functional Units 18 and 19): Landings (tonnes) by the Republic of Ireland, 1985-94

Year	FU 18			FU 19		
	Ireland	UK	Total	Ireland	UK	Total
1985	22	0	22	673	1	674
1986	8	0	8	474	<1	474
1987	9	0	9	725	2	727
1988	13	1	14	601	1	602
1989	11	<1	11	652	1	653
1990	5	0	5	569	2	571
1991	0	<1	0	860	5	865
1992	1	0	1	640	11	651
1993	9	1	10	672	3	675
1994*	0	0	0	347	3	350

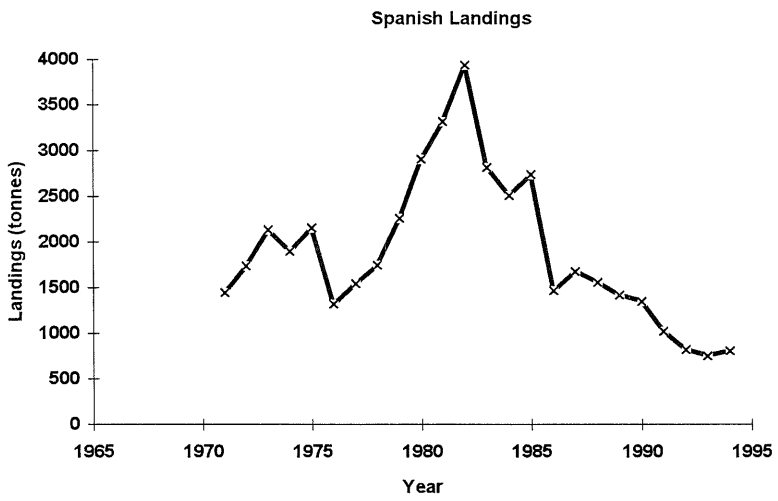
* provisional

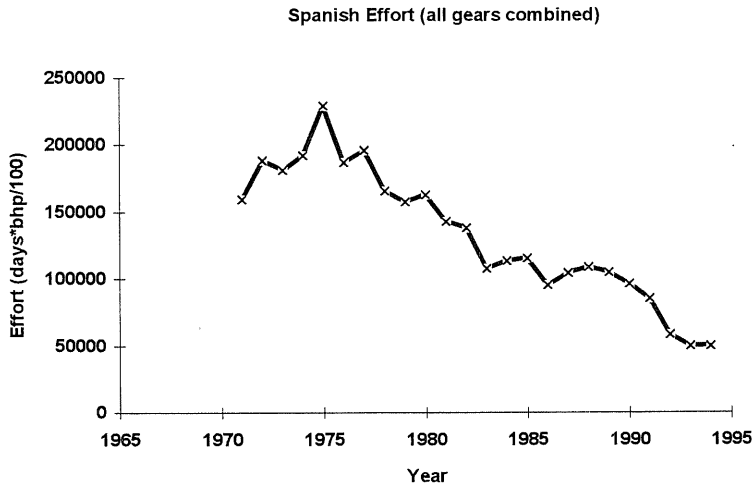
Table 5.13.8 Nephrops landings (tonnes) by Functional Unit plus other rectangles in Management Area L (VIIb,c,j,k)

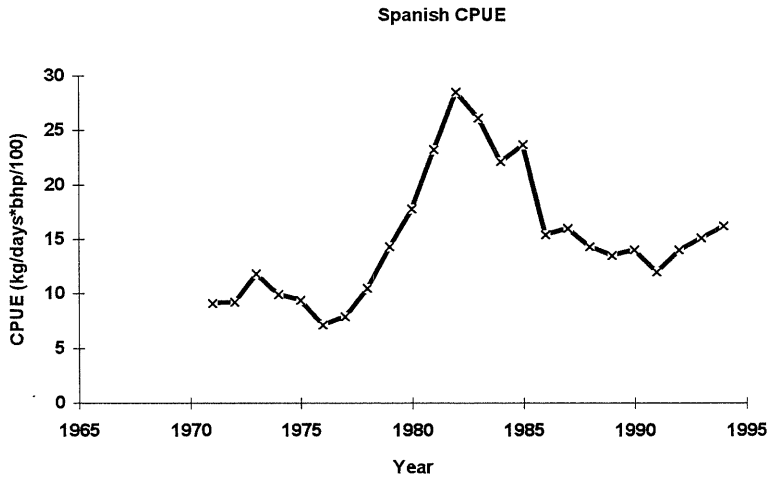
Year	FU 16	FU 17	FU 18	FU 19	Other	Total
1985	3953	1989	22	674	208	6846
1986	2569	1045	8	474	135	4231
1987	2439	1177	9	727	170	4522
1988	2329	753	14	602	187	3885
1989	2108	828	11	653	143	3743
1990	1883	345	5	571	114	2918
1991	1613	519	0	865	196	3193
1992	1968	412	1	651	454	3486
1993	1895	369	10	675	425	3374
1994	1974	192	0	350	376	2892

Table 5.13.9 Nephrops landings (tonnes) by country in Management Area L (VIIb,c,j,k)

Year	Spain	France	Ireland	UK	Total
1985	2889	1505	2360	92	6846
1986	1542	1267	1320	102	4231
1987	1735	756	1764	267	4522
1988	1617	662	1305	301	3885
1989	1505	338	1827	73	3743
1990	1436	363	1060	59	2918
1991	1152	378	1519	144	3193
1992	1139	676	1351	320	3486
1993	1075	876	1248	175	3374
1994	1069	868	761	192	2892







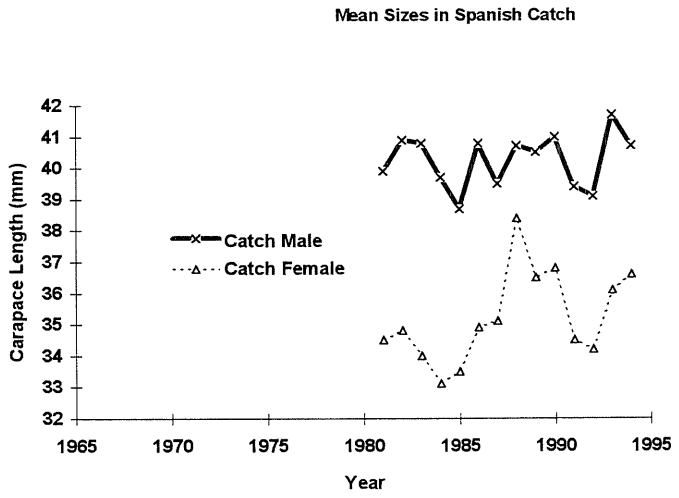


Figure 5.13.1 Porcupine Bank (FU16): Longterm trends in Spanish landings (tonnes), effort (days*bhp/100), CPUE (kg/days*bhp/100) and mean size in catch.

5.14. Divisions VIIf,g,h and VIIa 33E2-E5 (Management Area M)

Functional Units Celtic Sea (20-22)

The statistical rectangles comprising this Management Area and its constituent Functional Units are shown in Figure 5.1.2.

5.14.1. Celtic Sea (Functional Units 20-22)

Data and biological inputs

Samples of the length compositions of the French landings are available since 1987 (Table 5.14.1). Discards data are available for 1991 only, and the numbers discarded at length for the other years were derived from these data.

The biological parameters used in the assessments remained unchanged from those used last year (Table 5.14.1). This also refers to the size at maturity, which was raised last year from 24 to 31 mm CL, in line with the observations by Morizur (1982) on Celtic Sea females.

Comments on general quality of inputs

Because of a delay in the processing of the French landings and effort statistics, only partial landings data were available for 1994 at the time of the meeting. The estimate of the 1994 landings given in Table 5.14.2 was obtained by adding data directly obtained from the auctions, to the partial official landing statistics. The estimate of the effort was obtained by raising the partial effort to the corresponding level of the total annual landings.

Nephrops directed fishing effort by the French trawler fleet is obtained by selecting voyages for which more than 10% of the total value consists of *Nephrops* (or more than 10% of the total landed weight, when the value has not been recorded). The fishing hours of these trips are then summed, to obtain an overall estimate of the effort directed towards *Nephrops*.

Length composition data are collected every month in the main home ports of French *Nephrops* trawlers operating in the Celtic Sea. In the absence of an Irish sampling programme in the area, the length compositions of both the French and the Irish discards were derived from the French data on the length distribution of the discards, collected in 1991. Since the legal (EU) minimum landing size for *Nephrops* applied in the Republic of Ireland is much smaller than the minimum size acceptable to the French market, the use of the French discard data under-estimates the Irish removals-at-length, especially for the size classes at or just above the legal minimum landing size.

Landings

Landings are reported by France, the Republic of Ireland and the UK (Table 5.14.2). In the past, the French landings represented at least 80 % of the international *Nephrops* landings from the Celtic Sea. The increase in total landings, which has occurred over the past ten years, is almost exclusively due to a steady increase in the Irish landings, which reached nearly 1 000 t in 1994 (Table 5.14.2). Over the same period of time, the French landings have been fluctuating without obvious trend between 2 500 t and 3 500 t. The total landings from these FUs have increased slightly to about 4600 t in the last two years (Table 5.14.2, Figure 5.14.1).

Effort

Trends in the French effort are well documented for the Celtic Sea since the EU logbook is compulsory for all vessels fishing in the area. Overall effort by the French fleet has slightly decreased from 1985 to 1988, then it steadily increased until 1993, but in 1994 it dropped again (Table 5.14.3 and Figure 5.14.1). There are no effort data for the Irish trawlers operating in the Celtic Sea.

Quarterly effort reaches a peak during the 2nd and the 3rd quarter, when the availability of *Nephrops* is highest (Figure 5.14.2).

LPUE

The LPUE of the French *Nephrops* fleet gave peak values of about 15 kg/h from 1987 to 1989, it then decreased to 10 kg/h in 1991, and has since increased to 14 kg/h last year (Table 5.14.3). The LPUEs for the reference fleet of St Guénolé show the same trend. They were around 250 kg/day from 1985 to 1990, decreased to 181 kg/day in 1991, the lowest figure in the time series, and in 1994 they recovered again to 238 kg/day (Table 5.14.3).

The LPUEs of the males show no particular trend, but peak values occurred from 1987 to 1990 (Figure 5.14.2). The LPUEs of the females are very low compared to those of the males. The large commercial minimum landing size, combined with the difference in growth between the sexes, results in a very low retention rate of females during sorting.

Mean size

Mean sizes of male and female *Nephrops* in the landings and catches are given in Table 5.14.4 and shown in Figure 5.14.1. The mean sizes in the landings remained fairly stable over the period 1985-1994, with a slight increase since 1992. The mean sizes in the catches have been stable since the data series started in 1987. No mesh change has occurred during this period.

Assessments

Length-based assessments

An LCA was performed with length compositions averaged over the years 1991-1994. The results are similar to those of last year's assessment (Tables 5.14.5 & 6) and the Y/R curves are shown in Figure 5.14.3. The long-term Y/R curve for the males is rather flat-topped. Maximum landings (+13%) are expected to occur with a reduction in fishing effort of 50 %. For the females, the long-term Y/ curve is much more dome shaped, with a predicted long- R term gain of 30 % for a decrease of 60% in effort from current F to Fmax. The situation of the female stock with heavy over-exploitation is unusual when compared with other stocks, but can be explained by the fact that the commercial minimum landing size is clearly above the legal one, and this results in a large proportion of the females being discarded.

Age-based assessment

Since both French and Irish vessels are involved in this fishery, a multifleet assessment was performed. In the absence of data for the Irish fleet, this fleet was excluded from the tuning. The length distributions (1987-1994) were split into 6 nominal age groups (plus-group at 7), using the L2AGE slicing program (Tables 5.14.7 and 5.14.10). The VPA assessments were performed using XSA in the Lowestoft VPA suite.

Males

The years 1987 to 1989 showed strong years effects which prevented the tuning from converging. Therefore, these years were excluded for the final tuning procedure. Log-catchability residuals were quite high, but without any particular age effect, and lower year effects than in the complete data series for 1987-1994 (Table 5.14.8, Figure 5.14.4). The regression statistics of XSA showed that catchability was independent from year class strength for all ages (Table 5.14.8).

The fishing mortalities were quite low and fairly stable, fluctuating between 0.24 and 0.35 (Table 5.14.9). The regression of Fbar against effort is significant (P<0.02) (Figure 5.14.5). This was not the case in last year's assessment, based on the ad hoc tuning with TUNE1.

Both TSB and recruitment levels were very stable for all the years (Table 5.14.9, Figure 5.14.6).

Females

Again, the best results were obtained by excluding the years 1987 to 1989 from the tuning. The log-catchability residuals were quite high and there were clear year effects (Table 5.14.11, Figure 5.14.7). The age for which catchability was considered independent from population abundance was set at 3 (Table 5.14.11). The regression statistics show that catchability is probably independent of abundance for all ages but a new run was not performed because of a lack of time.

Fbar showed a slight increasing trend from 0.21 to 0.31 (Table 5.14.12, Figure 5.14.9). The regression of Fbar against effort is significant (P<0.02) (Figure 5.14.8).

The TSB and SSB decreased slightly over the time series and recruitment fluctuated without trend (Table 5.14.12, Figure 5.14.9).

General comments on quality of the assessments

The Celtic Sea comprises three FUs which, ideally, should be dealt with separately. Unfortunately, however, neither sampling nor the allocation of effort allow an acceptable break-down of the data by FU. This makes the assessments less reliable.

The relatively low values of the female TSB, compared with the males, raises doubts about the reliability of the VPA assessment for the females.

Management considerations

Although the LCA suggests that current F is above Fmax for both sexes, the VPA shows that fishing mortalities are not very high, and that total stock biomasses and spawning stock biomass are fairly stable. Therefore status quo advice in terms of effort and/or catches is recommended.

5.14.2. Summary of Divisions VIIf,g,h and VIIa 33E2-E5 (Management Area M)

Landings from other rectangles within MA M but outside FUs 20-22 are very small (Tables 5.14.13, 5.14.14). The management considerations for the FUs can thus be extended to the MA as a whole, and status quo effort or/and catches is recommended.

Table 5.14.1 Data and input parameters: Celtic Sea

FU	20-22	MA	M
FLEET	French	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch					
Landings	7	4	9	7	200
Discards					

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch		23	68	45	37	38	29	69	40	45
Landings	27	23	68	35	37	38	29	69	40	35
Discards			0	10	0	0	0	0	0	10

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	0.25	Gueguen and Charuau, 1975
MALES		
Growth - K	0.17	chosen for consistency with other stocks
Growth - L(inf)	68	French observations (Powell's method 1979)
Nat. Mort. - M	0.3	Morizur, 1982
Length/weight - a	0.000095	Charuau,1982
Length/weight - b	3.55	"
FEMALES		
Immature Growth		
K	0.17	chosen for consistency with other stocks
L(inf)	68	see males above
Nat.Mort. - M	0.3	as for males
Size at Maturity	31	Morizur, 1982
Mature Growth		
K	0.1	chosen for consistency with other stocks
L(inf)	49	French observations(Powell's method)
Nat.Mort. - M	0.2	assumed *
Length/weight - a	0.000095	as for males
Length/weight - b	3.55	"

* based on Morizur, 1982 and assuming lower female rate

Table 5.14.2 Celtic Sea (Functional Units 20, 21 and 22): Landings (tonnes) by country, 1985-94

Year	France 20-22	Ireland 22	UK 20-22	Belgium 20-22	Total
1985	3599	222	3	0	3824
1986	2633	167	<1	0	2800
1987	2806	329	<1	<1	3135
1988	2672	239	2	0	2913
1989	3083	784	14	0	3881
1990	3762	528	15	1	4306
1991	2652	644	13	2	3311
1992	3415	750	75	0	4240
1993	3815	770	47	0	4632
1994*	3596	953	56	0	4605

* provisional

Table 5.14.3 Celtic Sea (Functional units 20-22): Effort (days fishing) and LPUE (kg/day) of French trawlers, home port St Guénolé, 1985-94. Estimated total effort ('000 hours fished) and LPUE (kg/hour)

Year	Effort(days)	LPUE kg/day	Est. Total	LPUE
1985	4106	282	246	15
1986	4205	233	208	13
1987	4656	263	205	14
1988	4595	256	183	15
1989	4953	240	210	15
1990	5460	230	280	13
1991	5075	181	264	10
1992	5149	220	319	11
1993	5132	205	332	11
1994*	3039	238	264	14

* Provisional

Table 5.14.4 Celtic Sea (Functional Units 20-22): Mean sizes (CL mm) of male and female Nephrops in French landings, 1985-94

	Landings		Catch	
Year	Males	Females	Males	Females
1985	39.2	36.9		
1986	39.3	37.5		
1987	38.8	35.1	33.2	29.4
1988	35.7	34.7	31.7	28.8
1989	38.9	36.0	33.2	29.4
1990	39.7	35.4	33.8	29.7
1991	38.7	34.6	32.7	29.1
1992	37.6	34.9	32.8	29.0
1993	40.1	36.7	34.0	29.3
1994	40.3	37.6	33.2	29.5

Table 5.14.5 Celtic Sea (FU's 20-22): Males - LCA output.

COHORT ANALYSIS
L INFINITY = 68.0000 K = .1700
COHORT ANALYSIS BY EXACT CALCULATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
15.0	63.6	.3000	.2263	.0001	.0006	.3006	451961.6	98865.4	176764.0
17.0	92.9	.3000	.1165	.0002	.0019	.3019	422238.3	48330.0	131267.6
18.0	30.2	.3000	.1188	.0001	.0006	.3006	407646.5	47589.3	156606.0
19.0	541.2	.3000	.1213	.0014	.0116	.3116	393339.5	46818.1	184839.0
20.0	936.3	.3000	.1238	.0025	.0204	.3204	378752.8	45987.8	215895.8
21.0	1141.8	.3000	.1265	.0032	.0253	.3253	364020.0	45116.4	249838.0
22.0	1500.7	.3000	.1293	.0044	.0340	.3340	349343.2	44204.7	286632.8
23.0	2801.3	.3000	.1322	.0086	.0649	.3649	334580.9	43179.5	325650.1
24.0	4843.4	.3000	.1352	.0156	.1155	.4155	318825.4	41926.6	365510.4
25.0	7725.6	.3000	.1384	.0265	.1916	.4916	301403.5	40331.0	404127.3
26.0	8801.8	.3000	.1418	.0325	.2289	.5289	281577.3	38454.1	440562.0
27.0	10013.4	.3000	.1453	.0400	.2751	.5751	261237.6	36403.2	474541.7
28.0	9875.8	.3000	.1489	.0429	.2882	.5882	240301.0	34264.9	505925.4
29.0	10155.0	.3000	.1528	.0483	.3163	.6163	220145.8	32102.3	534613.6
30.0	10513.3	.3000	.1569	.0552	.3519	.6519	200360.1	29877.2	558981.6
31.0	10268.9	.3000	.1612	.0599	.3717	.6717	180883.6	27630.6	578624.1
32.0	9664.6	.3000	.1657	.0630	.3799	.6799	162325.5	25439.2	594224.9
33.0	8052.0	.3000	.1705	.0586	.3438	.6438	145029.2	23420.6	608236.0
34.0	7980.1	.3000	.1756	.0651	.3707	.6707	129951.0	21527.5	619667.8
35.0	8440.1	.3000	.1810	.0780	.4310	.7310	115512.6	19584.7	623038.4
36.0	7445.9	.3000	.1868	.0786	.4211	.7211	101197.1	17681.9	619967.7
37.0	7216.7	.3000	.1929	.0877	.4546	.7546	88446.6	15876.3	611935.5
38.0	7557.8	.3000	.1994	.1073	.5382	.8382	76466.9	14042.8	593547.2
39.0	6057.4	.3000	.2064	.1015	.4917	.7917	64696.3	12320.5	569725.0
40.0	5971.6	.3000	.2139	.1189	.5560	.8560	54942.8	10740.4	542157.5
41.0	4615.7	.3000	.2220	.1101	.4958	.7958	45749.1	9309.8	511917.5
42.0	4762.2	.3000	.2307	.1375	.5959	.8959	38340.4	7991.2	477692.4
43.0	3744.0	.3000	.2401	.1328	.5530	.8530	31180.9	6770.4	439132.0
44.0	2964.1	.3000	.2504	.1290	.5152	.8152	25405.8	5753.3	404153.6
45.0	2725.2	.3000	.2615	.1469	.5619	.8619	20715.7	4849.7	368326.1
46.0	1816.3	.3000	.2736	.1214	.4436	.7436	16535.6	4094.2	335617.5
47.0	1620.9	.3000	.2870	.1338	.4663	.7663	13491.1	3475.7	307025.6
48.0	1434.0	.3000	.3017	.1489	.4936	.7936	10827.5	2905.2	276121.4
49.0	1123.6	.3000	.3180	.1486	.4672	.7672	8521.9	2405.0	245573.6
50.0	1056.7	.3000	.3362	.1817	.5403	.8403	6676.8	1955.6	214234.1
51.0	725.4	.3000	.3566	.1646	.4614	.7614	5033.4	1571.9	184487.0
52.0	639.5	.3000	.3796	.1936	.5100	.8100	3836.5	1253.8	157448.7
53.0	453.1	.3000	.4058	.1867	.4599	.7599	2820.8	985.1	132192.5
54.0	397.6	.3000	.4359	.2284	.5239	.8239	2072.2	758.9	108694.4
55.0	904.3	.3000			.5000	.8000	1447.0	758.9	115874.3
			TOTAL BIOMASS INCLUDES LENGTHS ABOVE				+GP	924143.4	+16894230.0

Tables 5.14.6 Celtic Sea (FU's20-22): Females - LCA output.

COHORT ANALYSIS

LOWER CURVE LINF= 68.0000 K= .1700
UPPER CURVE LINF= 49.0000 K= .1000
TRANSITION LENGTH= 31.0000
COHORT ANALYSIS BY EXACT CALCULATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
14.0	68.1	.3000	.2220	.0004	.0016	.3016	200554.4	43065.7	6123.2
16.0	139.7	.3000	.1142	.0008	.0066	.3066	187566.6	21053.8	4668.2
17.0	190.7	.3000	.1165	.0011	.0092	.3092	181110.7	20721.5	5628.1
18.0	190.7	.3000	.1188	.0011	.0094	.3094	174703.6	20384.7	6708.1
19.0	361.7	.3000	.1213	.0022	.0181	.3181	168397.4	20036.0	7910.3
20.0	794.5	.3000	.1238	.0050	.0404	.3404	162024.9	19648.6	9224.3
21.0	1215.1	.3000	.1265	.0080	.0633	.3633	155335.7	19206.4	10635.8
22.0	1866.4	.3000	.1293	.0129	.0999	.3999	148358.6	18693.6	12121.4
23.0	4168.4	.3000	.1322	.0306	.2318	.5318	140883.9	17984.3	13563.4
24.0	5667.7	.3000	.1352	.0450	.3331	.6331	131319.5	17019.7	14837.6
25.0	6945.9	.3000	.1384	.0606	.4379	.7379	120544.6	15861.4	15893.5
26.0	6785.1	.3000	.1418	.0658	.4640	.7640	108840.4	14622.0	16752.3
27.0	7434.7	.3000	.1453	.0810	.5574	.8574	97668.7	13338.6	17387.8
28.0	7610.7	.3000	.1489	.0945	.6348	.9348	86232.4	11988.6	17701.3
29.0	7563.3	.3000	.1528	.1088	.7121	1.0121	75025.1	10621.2	17688.0
30.0	8055.1	.3000	.1569	.1372	.8748	1.1748	64275.4	9208.5	17228.4
31.0	7273.8	.2000	.1612	.1487	.9229	1.1229	53457.8	7881.1	16504.2
32.0	5856.8	.2000	.6062	.1499	.2473	.4473	44607.8	23687.0	55329.6
33.0	4877.5	.2000	.6454	.1656	.2565	.4565	34013.5	19013.5	49378.1
34.0	3254.3	.2000	.6899	.1477	.2141	.4141	25333.3	15203.4	43762.8
35.0	2462.0	.2000	.7411	.1495	.2018	.4018	19038.3	12202.4	38818.8
36.0	1813.6	.2000	.8004	.1492	.1863	.3863	14135.9	9732.5	34124.3
37.0	1655.9	.2000	.8701	.1904	.2189	.4189	10375.8	7565.9	29161.7
38.0	1396.5	.2000	.9531	.2383	.2500	.4500	7206.7	5585.5	23608.3
39.0	769.1	.2000	1.0536	.1998	.1896	.3896	4693.1	4055.4	18753.0
40.0	2075.3	.2000			.4000	.6000	3112.9	4055.4	20471.1
			TOTAL BIOMASS INCLUDES LENGTHS ABOVE			+GP	483544.8		1491302.0

Tables 5.14.7 Celtic Sea (FU's 20-22): Males - VPA input.

Catch numbers at age Numbers*10**-3

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	
AGE									
	1	3948	5524	4569	4420	4283	5876	4954	5291
	2	43363	64482	50096	45587	48616	64476	55195	56904
	3	43821	71356	48264	46453	48242	70339	46098	48603
	4	24894	20745	31290	28575	22119	40566	39773	32145
	5	9579	8097	14415	16106	10843	13824	23123	17569
	6	5194	3285	5641	7685	5171	5621	8799	6412
+gp		5318	2808	4505	5984	4116	4248	6994	6488
TOTALNUM		136117	176297	158780	154810	143390	204950	184936	173412
TONSLAND		2743	2587	3438	3889	2930	4051	4453	3964
SOPCOF %	64	59	70	75	69	69	69	71	

Catch weights at age (kg)

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	
AGE									
	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
	2	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
	3	0.024	0.023	0.024	0.024	0.024	0.024	0.024	0.024
	4	0.041	0.04	0.041	0.041	0.04	0.04	0.042	0.041
	5	0.06	0.06	0.06	0.061	0.061	0.06	0.06	0.06
	6	0.082	0.082	0.081	0.082	0.082	0.081	0.081	0.082
+gp		0.123	0.122	0.123	0.118	0.118	0.12	0.121	0.124
SOPCOFAC	0.6428	0.592	0.6958	0.7516	0.6946	0.6856	0.6947	0.7106	

Stock weights at age (kg)

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	
AGE									
	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
	3	0.024	0.023	0.024	0.024	0.024	0.024	0.024	0.024
	4	0.041	0.04	0.041	0.041	0.04	0.04	0.042	0.041
	5	0.06	0.06	0.06	0.061	0.061	0.06	0.06	0.06
	6	0.082	0.082	0.081	0.082	0.082	0.081	0.081	0.082
+gp		0.123	0.122	0.123	0.118	0.118	0.12	0.121	0.124

Natural Mortality (M) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	
AGE									
	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	6	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
+gp		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Proportion mature at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	
AGE									
	1	1	1	1	1	1	1	1	1
	2	1	1	1	1	1	1	1	1
	3	1	1	1	1	1	1	1	1
	4	1	1	1	1	1	1	1	1
	5	1	1	1	1	1	1	1	1
	6	1	1	1	1	1	1	1	1
+gp		1	1	1	1	1	1	1	1

Proportion of M before Spawning

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	
AGE									
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0
+gp		0	0	0	0	0	0	0	0

Proportion of F before Spawning

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	
AGE									
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0
+gp		0	0	0	0	0	0	0	0

Tables 5.14.8 Celtic Sea (FU's 20-22): Males - VPA tuning information.

Lowestoft VPA Version 3.1
Extended Survivors Analysis

Celtic Sea Nephrops males (20-22) 94

CPUE data from file c:\wgnep95\mceltic\lowestof\csmef94.dat 11
Catch data for 8 years. 1987 to 1994. Ages 1 to 7.

Fleet	First year	Last year	First year	Last age	Alpha age	Beta
Flt01 France ('000)	1990	1994	1	6	0	1

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages
Catchability independent of age for ages >= 5

Terminal population estimation :
Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 43 iterations

Regression weights

	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1990	1991	1992	1993	1994
1	0.01	0.011	0.014	0.011	0.011
2	0.158	0.156	0.246	0.205	0.197
3	0.35	0.28	0.4	0.314	0.314
4	0.486	0.314	0.457	0.47	0.426
5	0.478	0.386	0.373	0.59	0.443
6	0.356	0.308	0.4	0.491	0.358

XSA population numbers (Thousands)

	AGE					
YEAR	1	2	3	4	5	6
1990	5.33E+05	3.63E+05	1.83E+05	8.63E+04	4.93E+04	2.98E+04
1991	4.69E+05	3.91E+05	2.30E+05	9.54E+04	3.93E+04	2.26E+04
1992	4.75E+05	3.43E+05	2.48E+05	1.29E+05	5.16E+04	1.98E+04
1993	5.05E+05	3.47E+05	1.99E+05	1.23E+05	6.03E+04	2.63E+04
1994	5.85E+05	3.70E+05	2.09E+05	1.08E+05	5.71E+04	2.48E+04

Estimated population abundance at 1st Jan 1995

0.00E+00	4.28E+05	2.25E+05	1.13E+05	5.21E+04	2.72E+04

Taper weighted geometric mean of the VPA populations:

4.86E+05	3.47E+05	2.05E+05	1.04E+05	4.87E+04	2.39E+04

Standard error of the weighted Log(VPA populations) :

0.1131	0.0861	0.1247	0.1418	0.1976	0.1848

Tables 5.14.8 cont'd. Celtic Sea (FU's 20-22): Males - VPA tuning information.

Log catchability residuals.

Fleet : Flt01 France ('000)

Age	1990	1991	1992	1993	1994
1	-0.04	0.03	0.11	-0.13	0.03
2	-0.07	-0.11	0.12	-0.06	0.12
3	0.18	-0.07	0.05	-0.19	0.03
4	0.25	-0.21	-0.07	-0.04	0.07
5	0.19	-0.05	-0.32	0.14	0.05
6	-0.11	-0.28	-0.25	-0.04	-0.16

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6
Mean Log q		-10.368	-7.5514	-7.006	-6.7534	-6.7055	-6.7055
S.E(Log q)		0.0874	0.1112	0.1364	0.1709	0.2005	0.211

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	1.26	-0.376	9.65	0.42	5	0.12	-10.37
2	5.19	-0.718	-14.44	0.01	5	0.62	-7.55
3	1.27	-0.329	5.57	0.33	5	0.2	-7.01
4	1.7	-0.761	3.38	0.29	5	0.31	-6.75
5	0.77	0.438	7.66	0.55	5	0.17	-6.71
6	0.67	2.142	7.94	0.93	5	0.05	-6.87

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 France ('000)	441309	0.3	0	0	1	0.733	0.01
F shrinkage mean	395123	0.5				0.267	0.011

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N	s.e	Var	F Ratio
428484	0.26	0.06	2		0.222	0.011

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 France ('000)	225224	0.212	0.125	0.59	2	0.819	0.197
F shrinkage mean	225242	0.5				0.181	0.197

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N	s.e	Var	F Ratio
225227	0.2	0.08	3		0.408	0.197

Tables 5.14.8 cont'd. Celtic Sea (FU's 20-22): Males - VPA tuning information.

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 France ('000)	115976	0.174	0.047	0.27	3	0.841	0.308
F shrinkage mean	99528	0.5				0.159	0.351

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N	Var	F Ratio
113196	0.17	0.05	4	0.3	0.314

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 France ('000)	52472	0.155	0.067	0.43	4	0.838	0.423
F shrinkage mean	50403	0.5				0.162	0.438

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N	Var	F Ratio
52132	0.15	0.05	5	0.35	0.426

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 France ('000)	27125	0.147	0.029	0.2	5	0.83	0.443
F shrinkage mean	27366	0.5				0.17	0.44

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N	Var	F Ratio
27165	0.15	0.02	6	0.159	0.443

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1988

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 France ('000)	12082	0.156	0.059	0.37	5	0.823	0.376
F shrinkage mean	17035	0.5				0.177	0.281

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N	Var	F Ratio
12841	0.16	0.08	6	0.514	0.358

Tables 5.14.9 Celtic Sea (FU's 20-22): Males - VPA output.

Terminal Fs derived using XSA (With F shrinkage)

Fishing mortality (F) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94	
AGE										
	1	0.011	0.0155	0.0108	0.0097	0.0107	0.0145	0.0115	0.0106	0.0122
	2	0.1556	0.2789	0.2119	0.1578	0.1559	0.246	0.2046	0.1968	0.2158
	3	0.3171	0.4682	0.393	0.3501	0.2799	0.3996	0.3136	0.3145	0.3426
	4	0.3869	0.2724	0.4361	0.4857	0.3139	0.4567	0.4698	0.4258	0.4508
	5	0.3971	0.2325	0.3478	0.4777	0.3861	0.3727	0.5895	0.4426	0.4683
	6	0.2558	0.2558	0.2825	0.3557	0.3084	0.4002	0.4911	0.3576	0.4163
	+gp	0.2558	0.2558	0.2825	0.3557	0.3084	0.4002	0.4911	0.3576	
0	FBAR 1- 6	0.2539	0.2539	0.2803	0.3061	0.2425	0.3149	0.3467	0.2913	

Terminal Fs derived using XSA (With F shrinkage)

Stock number at age (start of year) Numbers*10**-3

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 87-92	AMST 87-92	
AGE												
	1	420122	417930	495113	533456	468620	474691	505379	584527	0	466572	468322
	2	349714	307836	304855	362856	391389	343476	346602	370130	428484	342028	343354
	3	187335	221751	172550	182724	229573	248104	198958	209263	225227	205175	207006
	4	90141	101064	102861	86287	95383	128550	123259	107715	113196	99856	100714
	5	33959	45352	57015	49270	39328	51623	60316	57079	52132	45423	46091
	6	26736	16912	26628	29831	22637	19802	26345	24781	27165	23324	23758
	+gp	27099	14311	21038	22937	17814	14762	20610	24760	25669		
0	TOTAL	1135106	1125156	1180060	1267360	1264745	1281009	1281470	1378256	871875		

Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 1- 6
1987	420122	22052	22052	2743	0.1244	0.2539
1988	417930	20780	20780	2587	0.1245	0.2539
1989	495113	22658	22658	3438	0.1517	0.2803
1990	533456	23103	23103	3889	0.1683	0.3061
1991	468620	22722	22722	2930	0.1289	0.2425
1992	474691	24065	24065	4051	0.1683	0.3149
1993	505379	24885	24885	4453	0.1789	0.3467
1994	584527	25330	25330	3964	0.1565	0.2913
Arith. Mean	487480	23199	23199	3507	0.1502	0.2862
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Tables 5.14.10 Celtic Sea (FU's 20-22): Females - VPA input.

Catch numbers at age Numbers*10**-3

YEAR		1987	1988	1989	1990	1991	1992	1993	1994
AGE									
	1	2989	4042	3544	3682	3146	4365	3724	3888
	2	32981	45602	41717	38633	38019	48148	45830	43617
	3	11044	14410	14572	14380	13095	15155	15633	13455
	4	8333	10100	11308	11595	10589	10633	11356	9759
	5	5131	5276	6671	6684	6913	6463	6114	6089
	6	3091	3068	3694	3925	3520	3780	3509	4045
+gp		6942	5110	7560	8310	4433	6994	8115	11584
TOTALNUM	70510	87609	89065	87208	79715	95537	94279	92437	
TONSLAND	392	324	429	501	365	374	362	642	
SOPCOF %	31	22	27	31	27	23	22	37	

Catch weights at age (kg)

YEAR		1987	1988	1989	1990	1991	1992	1993	1994
AGE									
	1	0.005	0.005	0.005	0.004	0.005	0.005	0.005	0.005
	2	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
	3	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
	4	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
	5	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
	6	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
+gp		0.043	0.05	0.046	0.045	0.043	0.04	0.043	0.046
SOPCOFAC	0.3092	0.2205	0.2685	0.3137	0.2689	0.234	0.2199	0.3671	

Stock weights at age (kg)

YEAR		1987	1988	1989	1990	1991	1992	1993	1994
AGE									
	1	0.005	0.005	0.005	0.004	0.005	0.005	0.005	0.005
	2	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
	3	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
	4	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
	5	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
	6	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
+gp		0.043	0.05	0.046	0.045	0.043	0.04	0.043	0.046

Natural Mortality (M) at age

YEAR		1987	1988	1989	1990	1991	1992	1993	1994
AGE									
	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Proportion mature at age

YEAR		1987	1988	1989	1990	1991	1992	1993	1994
AGE									
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	1	1	1	1	1	1	1	1
	4	1	1	1	1	1	1	1	1
	5	1	1	1	1	1	1	1	1
	6	1	1	1	1	1	1	1	1
+gp		1	1	1	1	1	1	1	1

Proportion of M before Spawning

YEAR		1987	1988	1989	1990	1991	1992	1993	1994
AGE									
	1	-1	-1	-1	-1	-1	-1	-1	-1
	2	-1	-1	-1	-1	-1	-1	-1	-1
	3	-1	-1	-1	-1	-1	-1	-1	-1
	4	-1	-1	-1	-1	-1	-1	-1	-1
	5	-1	-1	-1	-1	-1	-1	-1	-1
	6	-1	-1	-1	-1	-1	-1	-1	-1
+gp		-1	-1	-1	-1	-1	-1	-1	-1

Proportion of F before Spawning

YEAR		1987	1988	1989	1990	1991	1992	1993	1994
AGE									
	1	-1	-1	-1	-1	-1	-1	-1	-1
	2	-1	-1	-1	-1	-1	-1	-1	-1
	3	-1	-1	-1	-1	-1	-1	-1	-1
	4	-1	-1	-1	-1	-1	-1	-1	-1
	5	-1	-1	-1	-1	-1	-1	-1	-1
	6	-1	-1	-1	-1	-1	-1	-1	-1
+gp		-1	-1	-1	-1	-1	-1	-1	-1

Tables 5.14.11 Celtic Sea (FU's 20-22): Females - VPA tuning information.

Lowestoft VPA Version 3.1
Extended Survivors Analysis

Celtic Sea Nephrops females (20-22) 94

CPUE data from file c:\wgnep95\mceltic\lowestof\csfef94.dat 11

Catch data for 8 years. 1987 to 1994. Ages 1 to 7.

Fleet	First	Last year	First year	Last age	Alpha age	Beta
flt01 : France	100	1990	1994	1	6	0 1

Time series weights :
Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :
Catchability dependent on stock size for ages < 3
Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 3
Catchability independent of age for ages >= 5

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 48 iterations

Regression weights

	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1990	1991	1992	1993	1994
1	0.023	0.019	0.027	0.023	0.024
2	0.41	0.402	0.506	0.496	0.449
3	0.283	0.249	0.292	0.321	0.277
4	0.338	0.348	0.329	0.371	0.341
5	0.325	0.347	0.371	0.32	0.349
6	0.291	0.284	0.324	0.354	0.364

XSA population numbers (Thousands)

	AGE					
YEAR	1	2	3	4	5	6
1990	1.84E+05	1.33E+05	6.46E+04	4.46E+04	2.66E+04	1.72E+04
1991	1.94E+05	1.33E+05	6.56E+04	3.98E+04	2.61E+04	1.58E+04
1992	1.89E+05	1.41E+05	6.62E+04	4.19E+04	2.30E+04	1.51E+04
1993	1.93E+05	1.36E+05	6.29E+04	4.05E+04	2.47E+04	1.30E+04
1994	1.90E+05	1.40E+05	6.15E+04	3.74E+04	2.28E+04	1.47E+04

Estimated population abundance at 1st Jan 1995

0.00E+00	1.38E+05	6.62E+04	3.81E+04	2.18E+04	1.32E+04

Taper weighted geometric mean of the VPA populations:

1.91E+05	1.38E+05	6.61E+04	4.20E+04	2.53E+04	1.56E+04

Standard error of the weighted Log(VPA populations) :

0.0317	0.0361	0.0517	0.0702	0.0773	0.1029

Log catchability residuals.

Fleet : flt01 : France 100

Age	1990	1991	1992	1993	1994
1	0.01	-0.01	0	0.02	-0.03
2	0.03	0	-0.02	-0.06	0.05
3	0.13	-0.02	-0.1	-0.06	0.05
4	0.11	0.11	-0.17	-0.11	0.06
5	0.08	0.12	-0.04	-0.26	0.1
6	-0.03	-0.08	-0.18	-0.16	0.14

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6
Mean Log q	-7.1663	-6.9715	-6.982	-6.982
S.E(Log q)	0.0895	0.1342	0.1609	0.1438

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	-0.18	-2.068	12.6	0.51	5	0.02	-9.67
2	0.64	0.368	8.56	0.26	5	0.05	-6.71

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	28.89	-0.602	******	0	5	2.82	-7.17
4	1.08	-0.065	6.67	0.17	5	0.17	-6.97
5	0.7	0.325	7.92	0.28	5	0.13	-6.98
6	0.77	0.416	7.63	0.53	5	0.11	-7.04

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
flt01 : France 100	133861	0.3	0	0	1	0.014	0.025
P shrinkage mean	137656	0.04				0.981	0.024
F shrinkage mean	143290	0.5				0.005	0.023

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N s.e	Var	F Ratio
137630	0.04	0.02	3	0.556	0.024

Age 2 Catchability dependent on age and year class strength

Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
flt01 : France 100	68663	0.212	0.011	0.05	2	0.036	0.436
P shrinkage mean	66130	0.05				0.954	0.45
F shrinkage mean	64866	0.5				0.01	0.457

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N s.e	Var	F Ratio
66206	0.05	0.02	4	0.428	0.449

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
flt01 : France 100	38324	0.179	0.032	0.18	3	0.822	0.276
F shrinkage mean	37331	0.5				0.178	0.282

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N s.e	Var	F Ratio
38146	0.17	0.02	4	0.144	0.277

Tables 5.14.11 cont'd. Celtic Sea (FU's 20-22): Females - VPA tuning information.

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
flt01 : France 100	21812	0.16	0.028	0.17	4	0.836	0.34
F shrinkage mean	21468	0.5				0.164	0.345

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N	s.e	Var	F Ratio
21755	0.16	0.02	5		0.143	0.341

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
flt01 : France 100	13085	0.147	0.045	0.31	5	0.849	0.351
F shrinkage mean	13852	0.5				0.151	0.335

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N	s.e	Var	F Ratio
13198	0.15	0.04	6		0.266	0.349

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 1988

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
flt01 : France 100	7953	0.147	0.082	0.56	5	0.849	0.379
F shrinkage mean	10897	0.5				0.151	0.29

Weighted prediction :

Survivors at end of year	Int	Ext s.e	N	s.e	Var	F Ratio
8340	0.15	0.09	6		0.598	0.364

Tables 5.14.12 Celtic Sea (FU's 20-22): Females - VPA output.

Run title : Celtic Sea Nephrops females (20-22) 94
Terminal Fs derived using XSA (With F shrinkage)

Fishing mortality (F) at age

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94
	AGE									
	1	0.0172	0.0253	0.0226	0.0235	0.019	0.0272	0.0226	0.024	0.0246
	2	0.3366	0.442	0.4423	0.41	0.4018	0.5061	0.4958	0.4492	0.4837
	3	0.1973	0.2543	0.2588	0.2826	0.2492	0.2919	0.3211	0.277	0.2967
	4	0.2478	0.2791	0.3251	0.3384	0.3478	0.3294	0.3713	0.3407	0.3471
	5	0.265	0.2452	0.3008	0.3248	0.347	0.3711	0.3202	0.3488	0.3467
	6	0.2138	0.2505	0.2714	0.2906	0.2835	0.3244	0.3538	0.3638	0.3473
	+gp	0.2138	0.2505	0.2714	0.2906	0.2835	0.3244	0.3538	0.3638	
0	FBAR 1- 6	0.2129	0.2494	0.2702	0.2783	0.2747	0.3084	0.3141	0.3006	

Terminal Fs derived using XSA (With F shrinkage)

Stock number at age (start of year) Numbers*10**-3

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 87-92	AMST 87-92
	AGE											
	1	203679	187745	184259	184464	193786	188939	193368	190300	0	190363	190479
	2	134054	148317	135606	133452	133486	140853	136213	140045	137630	137524	137628
	3	68178	70923	70626	64553	65612	66165	62905	61463	66206	67632	67676
	4	41957	45826	45028	44639	39840	41870	40459	37358	38146	43141	43193
	5	24360	26811	28381	26634	26056	23036	24659	22850	21755	25820	25880
	6	17749	15302	17177	17200	15758	15078	13013	14657	13198	16345	16377
	+gp	39651	25341	34937	36182	19719	27702	29870	41657	32045		
0	TOTAL	529629	520266	516013	507124	494257	503644	500486	508329	308980		

Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 1- 6
1987	203679	7430	3598	392	0.109	0.2129
1988	187745	7190	3280	324	0.0988	0.2494
1989	184259	7445	3505	429	0.1224	0.2702
1990	184464	7098	3356	501	0.1493	0.2783
1991	193786	6411	2738	365	0.1333	0.2747
1992	188939	6686	2833	374	0.132	0.3084
1993	193368	6725	2834	362	0.1277	0.3141
1994	190300	7295	3209	642	0.2001	0.3006
Arith. Mean	190818	7035	3169	424	0.1341	0.2761
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 5.14.13 Nephrops Landings (tonnes) by Functional Unit plus Other rectangles in Management Area M (VIIf,g,h, & VIIa rectangles 33E2-E5)

Year	FU 20-22	Other	Total
1985	3824	24	3848
1986	2800	5	2805
1987	3135	236	3371
1988	2913	156	3069
1989	3881	107	3988
1990	4306	75	4381
1991	3311	20	3331
1992	4240	29	4269
1993	4632	42	4674
1994	4605	75	4680

Table 5.14.14 Total Nephrops Landings (tonnes) by country in Management Area M (VLLf,g,h & VIIa rectangles 33E2-E5)

Year	France	Ireland	UK	Belgium	Total
1985	3623	222	3	?	3848
1986	2638	167	<1	0	2805
1987	3041	329	1	0	3371
1988	2827	239	3	0	3069
1989	3185	784	19	<1	3988
1990	3834	528	18	1	4381
1991	2670	644	15	2	3331
1992	3440	750	79	0	4269
1993	3841	770	63	0	4674
1994	3645	953	82	0	4680

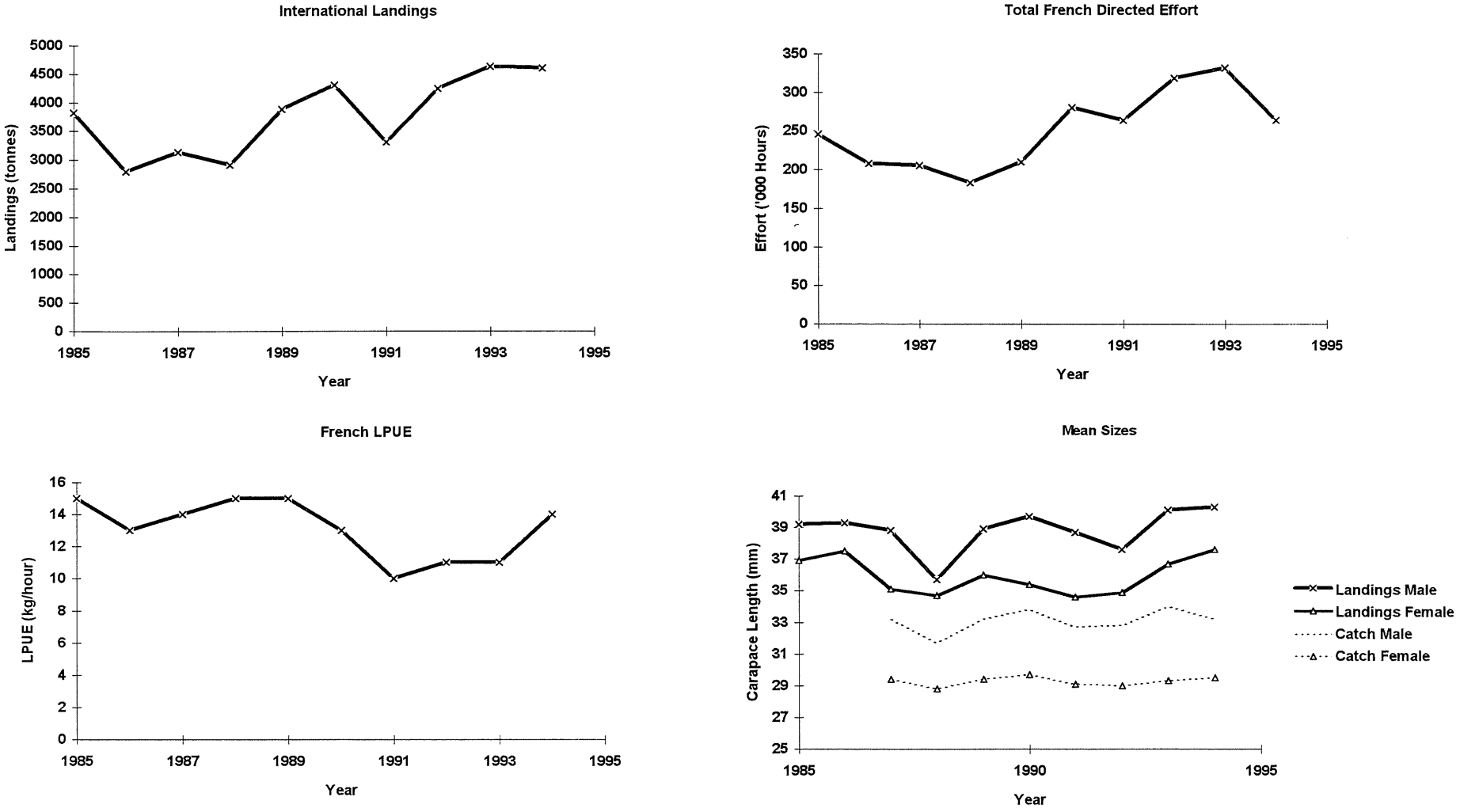


Figure 5.14.1 Celtic Sea (FU's 20-22): Long term trends in French landings (tonnes), directed effort ('000 hours), LPUE (kg/hour) and mean size (mm CL) in landings and catch by sex.

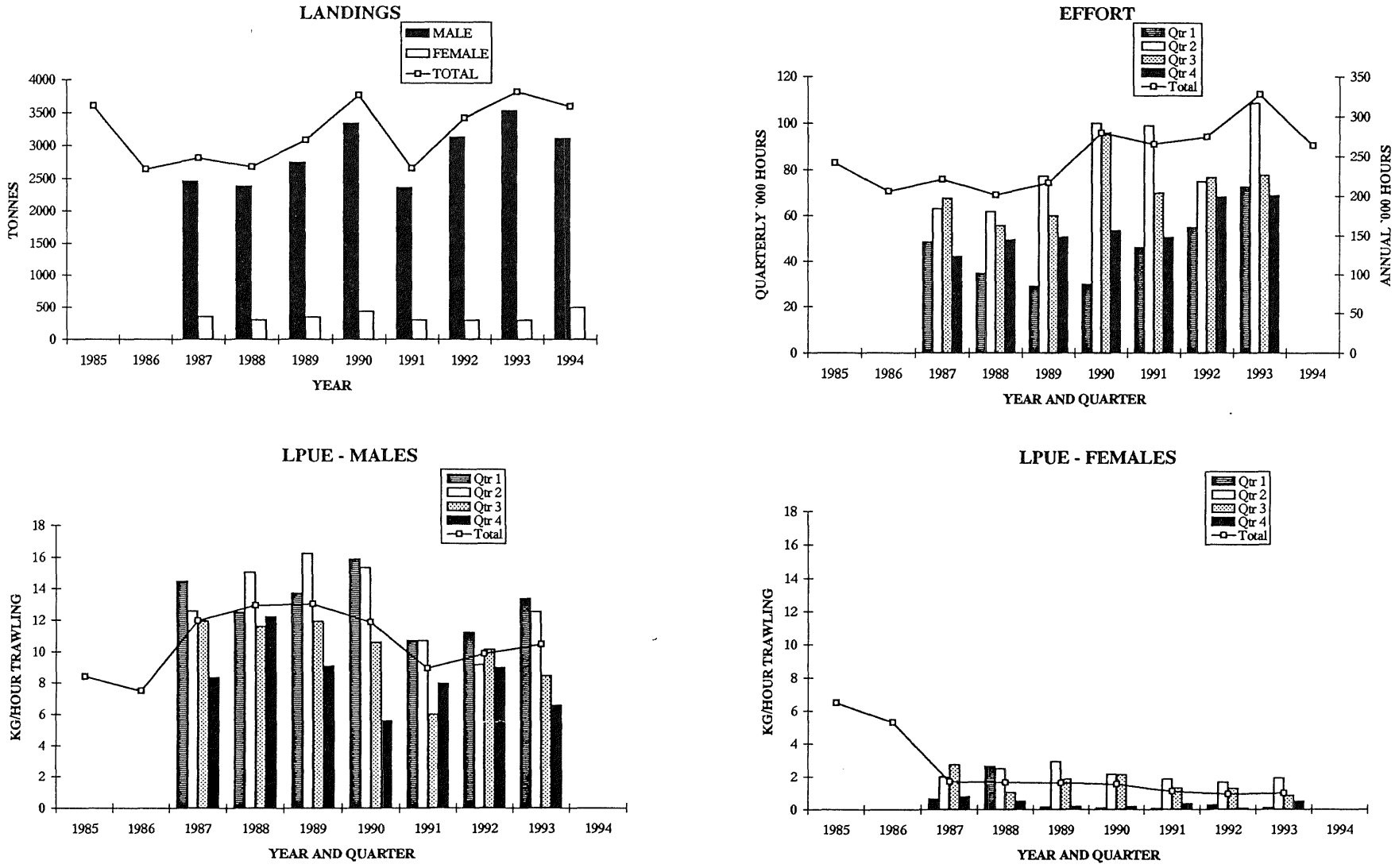


Figure 5.14.2. Celtic Sea (functional unit 20-22) : trends in landings,effort and LPUE by quarter and sex from French Nephrops trawlers.

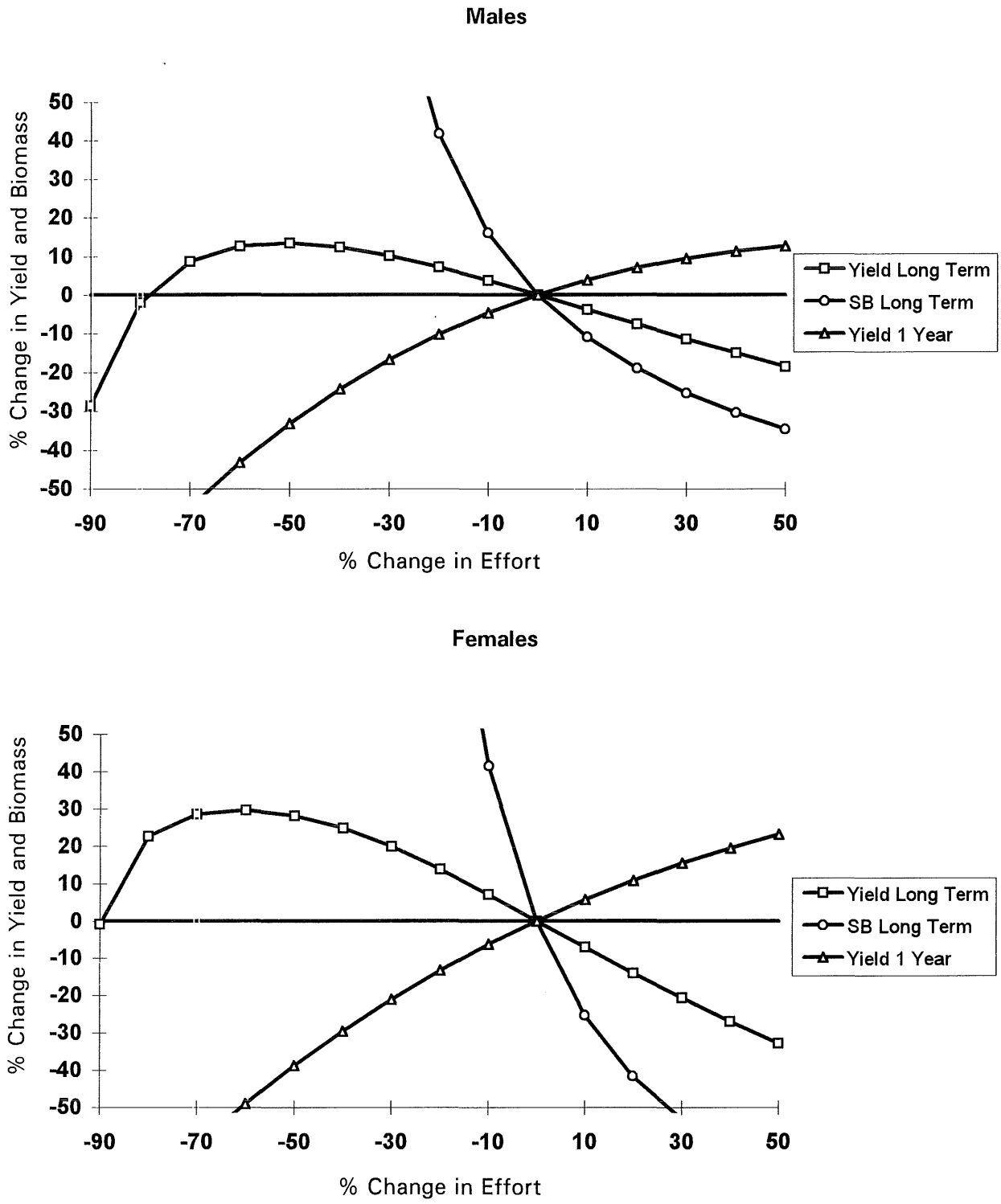


Figure 5.14.3 Celtic Sea (FU's 20-22): Percentage changes in long term landings and stock biomass, and short term landings following various changes in fishing effort. Males and females shown separately

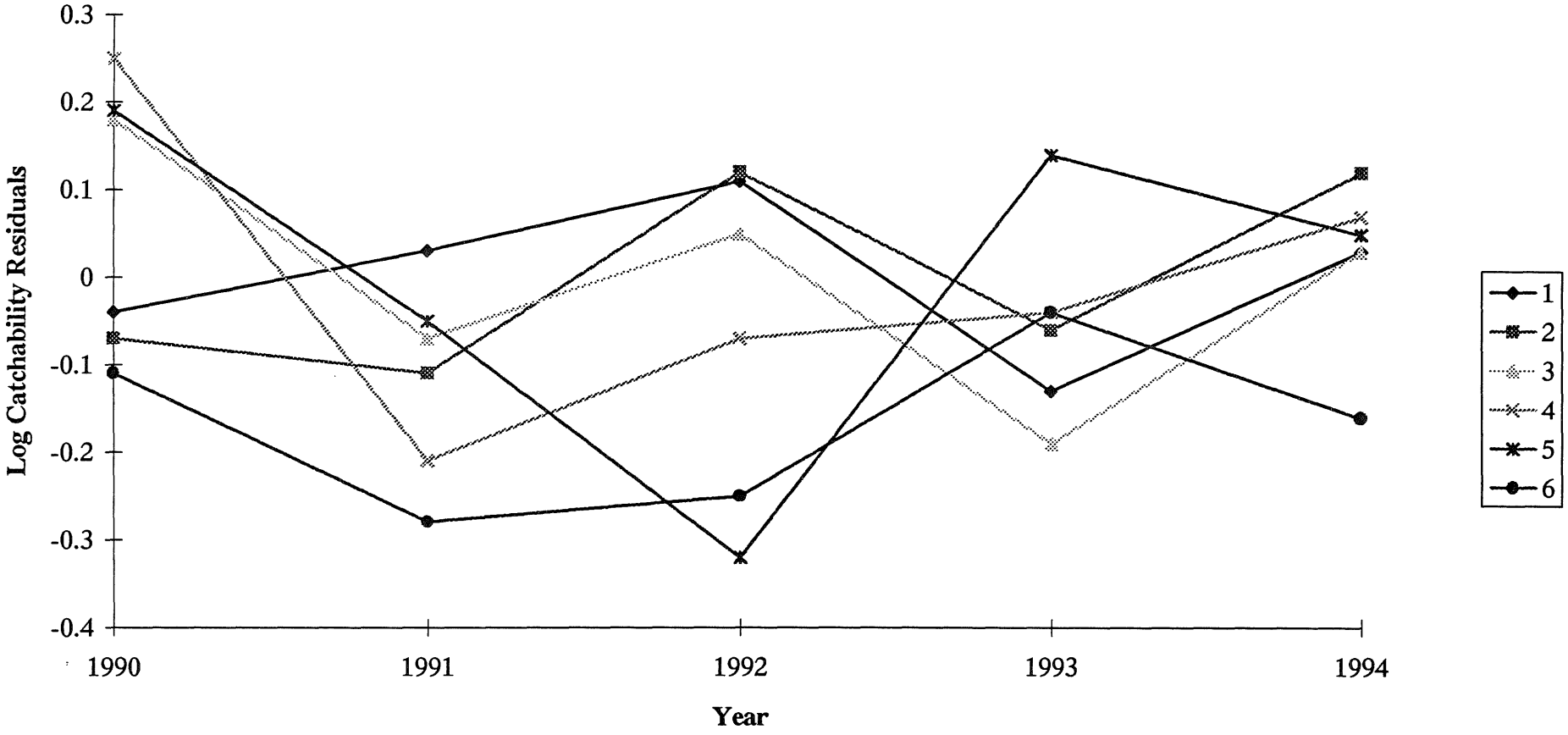
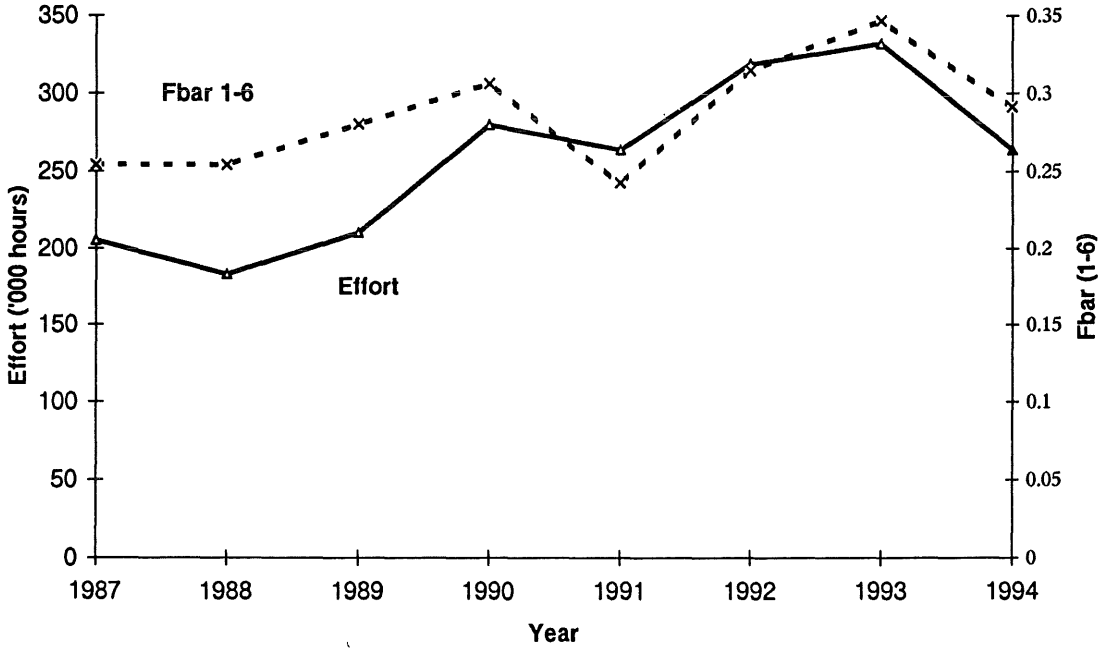


Figure 5.14.4 Celtic Sea (FU's 20-22): Males log catchability residuals from XSA



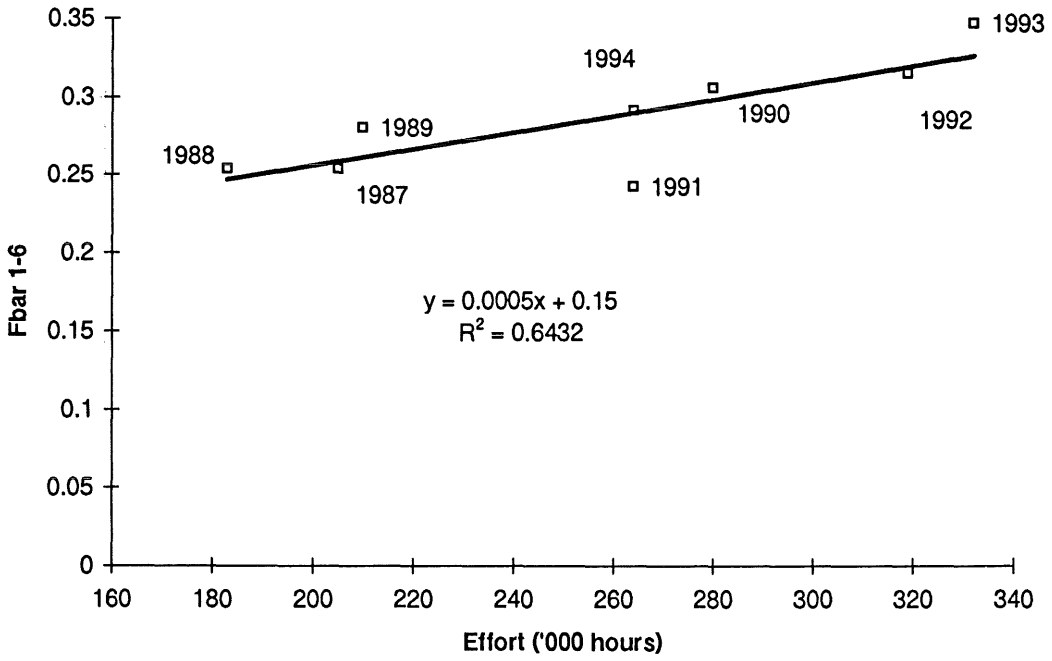


Figure 5.14.5 Celtic Sea (FU's 20-22): Males - plot of effort and Fbar from XSA, together with their regression.

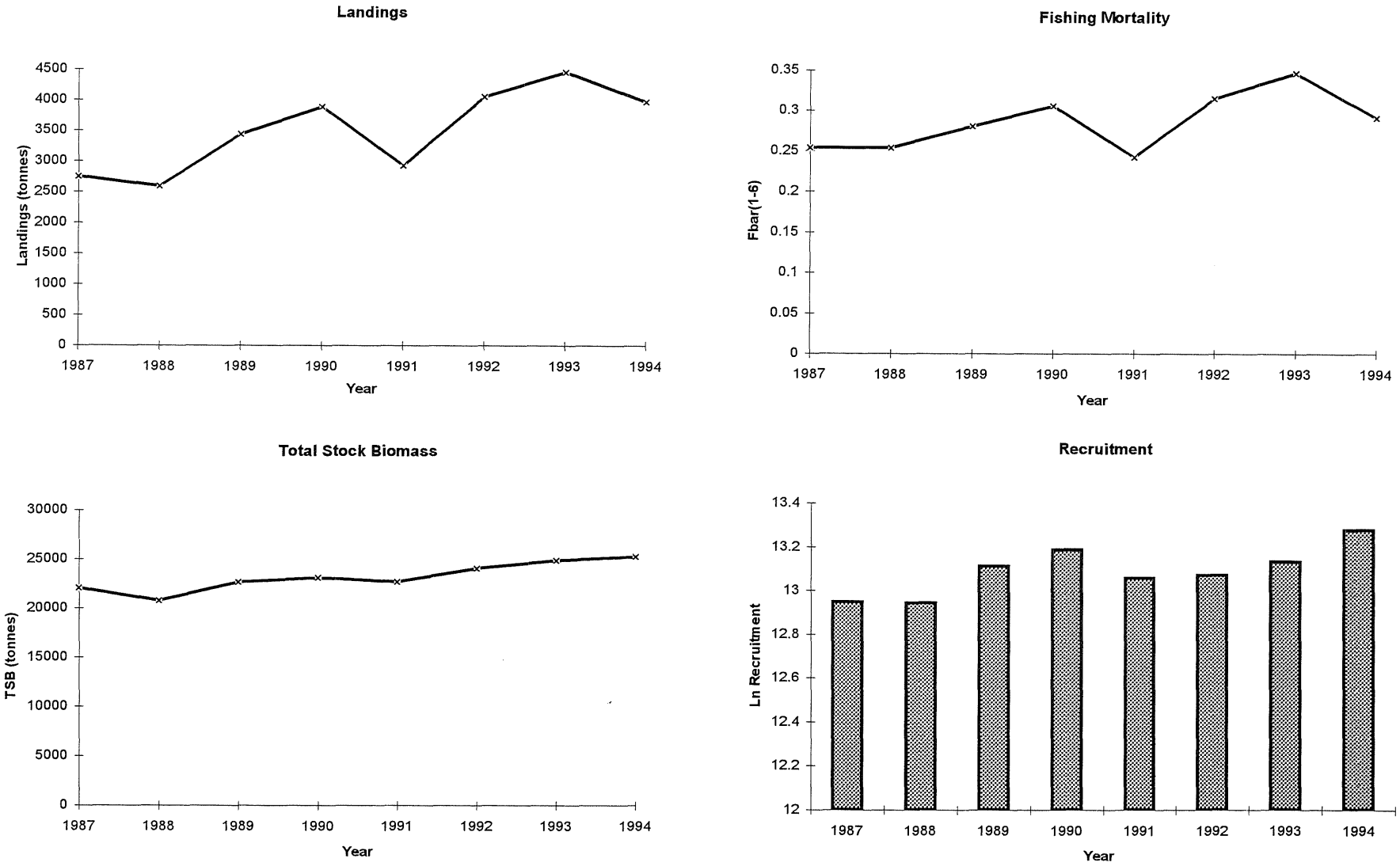


Figure 5.14.6 Celtic Sea (FU's 20-22): Males - trends in landings, fishing mortality, total stock biomass, and Ln recruitment from XSA.

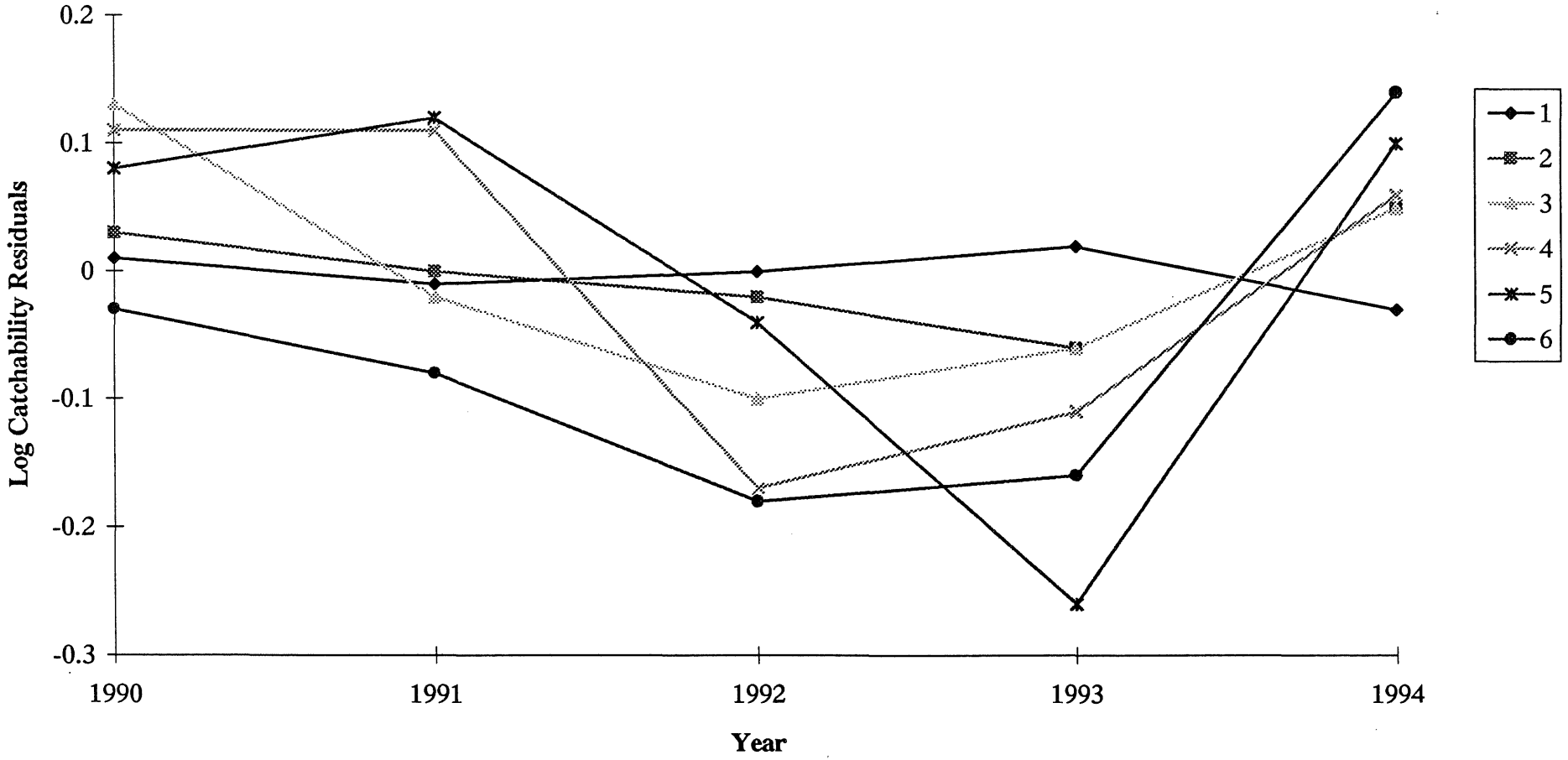
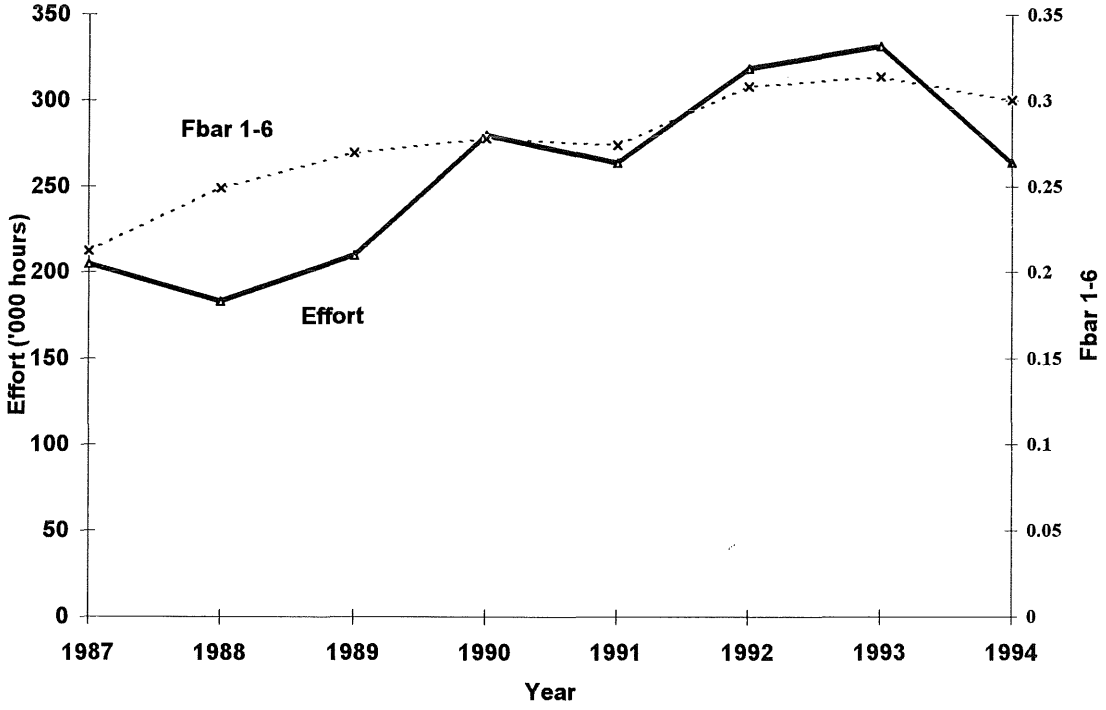


Figure 5.14.7 Celtic Sea (FU's 20-22): Females - log catchability residuals from XSA



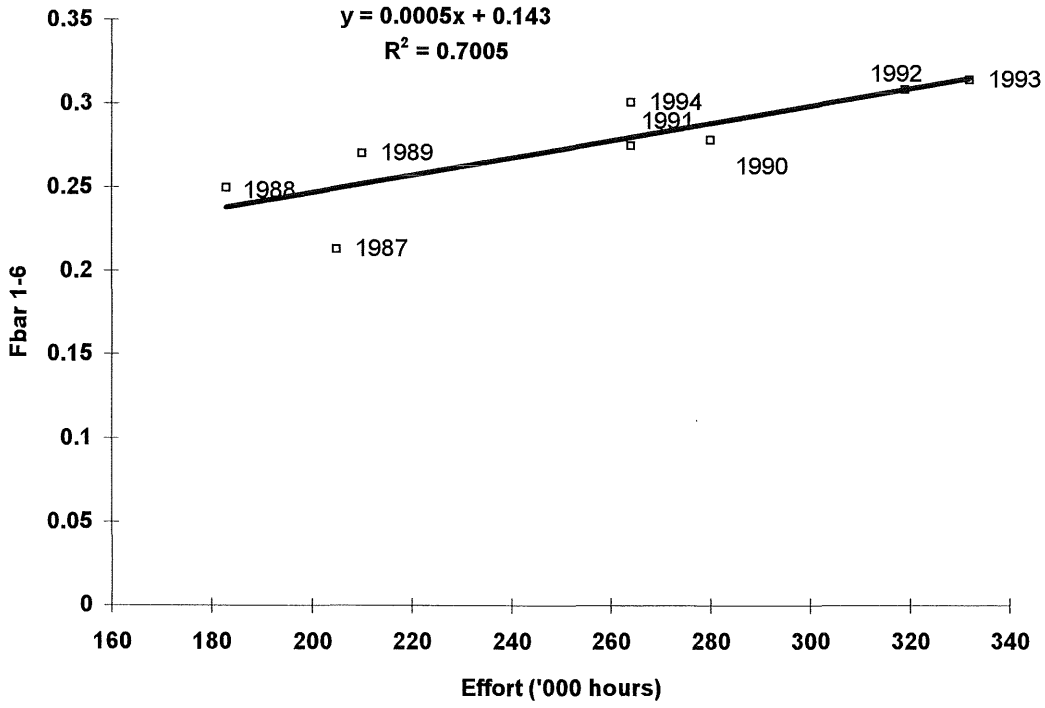
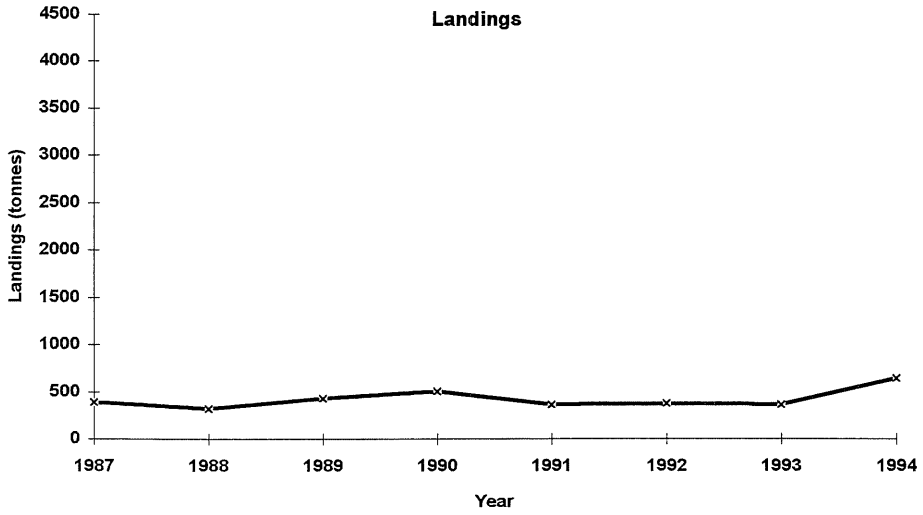
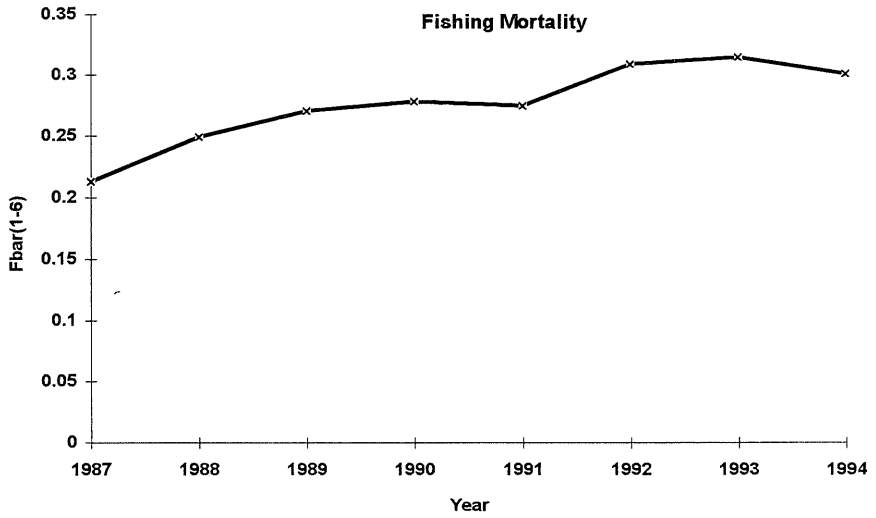


Figure 5.14.8 Celtic Sea (FU's 20-22): Females - plot of effort and Fbar from XSA, together with their regression.





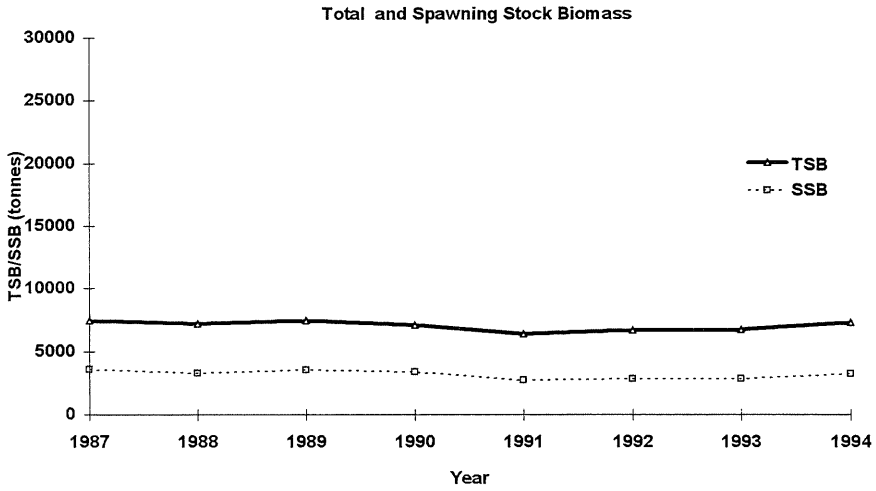


Figure 5.14.9 Celtic Sea (FU's 20-22): Females - trends in landings, fishing mortality, total and spawning stock biomass, and Ln recruitment from XSA.

5.15. Divisions VIIIa,b (Management Area N)

Functional Units Bay of Biscay (23-24)

The statistical rectangles comprising this Management Area and its constituent Functional Units are shown in Figure 5.1.3.

5.15.1. Bay of Biscay (Functional Units 23+24)

Data and biological inputs

Length compositions of the French landings have been sampled since 1984 (Table 5.15.1). Discard data are available for 1987 and 1991 only, and the numbers discarded at length for the other years were derived from these data.

The biological parameters are given in Table 5.15.1. All parameters used in the assessments remained unchanged.

Comments on the general quality of the inputs

Length frequency data are available on a monthly basis from samples of the landings taken in the northern part of the Bay of Biscay, where 70-80% of the overall landings from Divisions VIIIa and VIIIb are taken. Because of insufficient technical and financial resources, only two discard sampling programmes have been performed in 1985 and 1991. The length compositions of the discards for the other years are derived from these two data sets; those for 1984-1990 from the 1985 discard data, and those for 1992-1994 from the 1991 data.

Estimates of the *Nephrops* directed effort are based on independent sources of information on the landings composition and the numbers of hours fished per voyage. Voyages are considered to be directed towards *Nephrops* when more than 10% of their revenue is accounted for by *Nephrops* (or more than 10% of the weight landed, if the revenue was not recorded). The number of these voyages is then multiplied by the average number of hours trawling per voyage, obtained from an inquiry amongst fishermen, to give an overall estimate of the *Nephrops* directed fishing effort. The figure thus obtained must be considered as a fairly rough estimate, since most of the vessels involved in this fishery are not required to submit EU-logbooks.

Landings

Because of a serious delay in the processing of the landings and effort statistics for 1994, only partial data were available at the time of the meeting. The estimates of the 1994 landings given in Table 5.15.2 were obtained by adding landing figures directly obtained from the auction halls to the partial data available. Estimates of the total *Nephrops* directed effort were calculated by raising the known (partial) effort to the level of the estimated landings for 1994.

Until 1993, the landings have been fluctuating without obvious trend around an average of 5 000 t per year (Table 5.15.2, Figure 5.15.1). In 1994, however, they dropped to 3 611 t, the lowest figure in the time series. Over 99 % of these are taken by French trawlers. A few landings are reported by Spain, from rectangles outside the FUs, but inside the MA (Table 5.15.14).

Effort

The estimated total effort has been fairly stable since 1988 (Table 5.15.3, Figure 5.15.1). The apparent increase from 1985 to 1988 was due to improvements in the recording system of the fishery statistics. The effort dropped in 1994, for the Bay of Biscay as a whole, as well as for the *Nephrops* fleet of Lesconil which is taken as a reference in terms of trends. For this fleet, effort has been well over 5 000 days per year from 1985 to 1989, then stabilised around 5 000 days from 1990 to 1993. In 1994, it decreased to 4 463 days, the lowest figure in the series. This could be explained by a change in fishing practice, with a tendency to direct effort to finfish in the season of low *Nephrops* availability, and by the decrease in the number of fishing vessels following the decommission scheme implemented by the EU.

LPUE

The LPUEs of the *Nephrops* fleet are fairly stable, fluctuating around 8 kg/hour (Table 5.15.3, Figures 5.15.1-2). Up to 1993, the LPUEs for the reference port of Lesconil showed no particular trend, with values fluctuating between 84 and 119 kg/day, and averaging 94 kg/day. In 1994, however, the LPUEs dropped well below the mean to 76 kg/day.

Mean size

Until 1990, there has been a slight increase in the mean size of *Nephrops* in the landings, particularly the males (Table 5.15.4, Figure 5.15.1). Since then, the mean size has stabilised, despite an increase in mesh size from 50 to 55 mm in 1990.

Mean sizes in the catches (Table 5.15.4, Figure 5.15.1) are presented only since 1991. The data for the previous years were not available at the time of the meeting. The mean sizes of male and female *Nephrops* in the catches have been reasonably stable for the last four years.

Assessments

Length Cohort Analysis

Because of the mesh size increase in 1990, only the average length compositions of the landings and discards over the period 1991-1994 were used to carry out an LCA.

The results are similar to those of last year's assessment (Tables 5.15.5 & 5.15.6, Figure 5.15.3). For the males, maximum landings (+19 %) would be obtained by reducing fishing effort by 60 %. For the females, the long-term Y/R curve is flat-topped, with current F at 40 % above Fmax, and a small long-term gain of 9 % following a reduction of F to Fmax.

Age-based assessment

The length distributions (1984-1994) were split into 6 nominal male age groups (plus-group at 7) and 9 nominal age groups (plus-group at 10) for females, using the L2AGE slicing program (Tables 5.15.7 and 5.15.10). The VPA assessments were performed using XSA in the Lowestoft VPA suite.

Males

Following examination of the regression statistics, catchability for all ages was assumed to be independent of abundance. All other inputs to the VPA were chosen as suggested by the program's defaults.

The catchability residuals are low for all years and ages, except for age 1 (Table 5.15.8, Figure 5.15.4). This might be due to a doubtful slicing of the length compositions, but this would need to be examined in detail before definite conclusions could be drawn.

Fbar fluctuated between 0.45 and 0.76, with a decreasing trend in the last two years (Table 5.15.9, Figure 5.15.6). The regression of Fbar on effort is just significant (P=0.05) (Figure 5.15.5), which was not the case in previous assessments using ad hoc tuning with TUNE1.

Total biomass increased until 1987, then gradually decreased. The recruitment plot shows higher levels of recruitment from 1984 to 1988, and lower but stable values thereafter (Table 5.15.9, Figure 5.15.6).

Females

The regression statistics showed that catchability is independent of abundance for all ages > 2. The log catchability residuals show year effects in almost all years (Table 5.15.11, Figure 5.15.7).

The values of Fbar are quite high, particularly in the years 1984-1986, and again in 1992-1994, with a peak value of 0.8 in 1993 (Table 5.15.12, Figure 5.15.9). The regression of Fbar on effort was not significant (P>0.05) (Figure 5.15.8).

Female SSB has been stable for the last ten years, but female recruitment shows a slight decreasing trend (Table 5.15.12, Figure 5.15.9).

General comments on quality of assessment

The growth parameters, particularly for the males, remain one of the main sources of uncertainty in these assessments. Other sources of uncertainty are related to the estimation of fishing effort and the annual length compositions of the discards.

The use of the Lowestoft package, however, has improved the overall quality of the assessment on the males, as compared with previous years.

Management considerations

The conclusion of the length based assessments is that fishing mortality should be reduced. The trends in fishing mortality and TSB for both males and females, as given by the age based assessment, on the other hand, show that there is no immediate reason for concern about this fishery. A status quo option for effort and/or catches is recommended.

5.15.2. Summary of Division VIIIa,b (Management Area N)

Landings from other rectangles within MA N but outside FUs 23-24 remain very small (Tables 5.15.13 & 14) Therefore, the management considerations for these FUs are extended to the MA as a whole, i.e. a status quo option for effort and/or catches.

Table 5.15.1 Data and input parameters: Bay of Biscay

FU	23 & 24	MA	N
FLEET	French	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch					
Landings	36	48	44	36	50
Discards					

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch										
Landings	164	184	382	223	208	346	252	329	315	352
Discards				42				12		

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	0.3	Gueguen and Charuau, 1975
MALES		
Growth - K	0.14	Adapted from Conan and Morizur, 1979 *
Growth - L(inf)	76	"
Nat. Mort. - M	0.3	Morizur, 1982
Length/weight - a	0.00039	Conan, 1978
Length/weight - b	3.18	"
FEMALES		
Immature Growth		
K	0.14	see males above: Note that new unpublished
L(inf)	76	data have led to changes in K *
Nat.Mort. - M	0.3	Morizur, 1982
Size at Maturity	25	
Mature Growth		
K	0.11	see note for immatures above
L(inf)	56	"
Nat.Mort. - M	0.2	assumed **
Length/weight - a	0.00081	Conan, 1978
Length/weight - b	2.97	"

* previously, K on males =0.11 and on mature females =0.14

** based on Morizur, 1982 and assuming lower female rate

Table 5.15.2 Bay of Biscay (Functional Units 23 and 24): Landings (tonnes) by country, 1985-94

Year	France FU 23	France FU 24	Belgium FU 23 and 24	Total
1985	4281	312	0	4593
1986	3968	367	0	4335
1987	5074	473	0	5547
1988	6019	658	0	6677
1989	4600	630	0	5230
1990	4603	358	1	4962
1991	4352	401	<1	4753
1992	5123	558	0	5681
1993	4404	512	0	4916
1994*	NA	NA	<1	3611

* provisional

Table 5.15.3 Bay of Biscay (Functional units 23 & 24): Effort (days fishing) and LPUE (kg/day) of French trawlers, home port Lesconil, 1985-94. Estimated total effort ('000 hours fished) and LPUE (kg/hour)

Year	Effort (days)	LPUE (kg/day)	Est Total effort	LPUE kg/hr
1985	5603	88	569	8
1986	5137	95	534	8
1987	5673	106	621	9
1988	5433	119	753	9
1989	5449	95	713	7
1990	4929	87	676	7
1991	4588	84	675	7
1992	4998	101	749	8
1993	5156	89	689	7
1994*	4463	76	467	8

Table 5.15.4 Bay of Biscay (Functional Units 23 & 24): Mean sizes (CL mm) of male and female Nephrops in French landings, 1985-94

Year	Landings		Catch	
	Males	Females	Males	Females
1985	26.1	26.7		
1986	27.3	27.7		
1987	28.8	26.3		
1988	28.5	26.2		
1989	29.2	26.8		
1990	31.2	27.9		
1991	30.7	28.4	27.7	25.4
1992	29.7	27.7	26.2	25.3
1993	29.4	27.9	26.9	25.3
1994	30.3	28.2	27.5	26.1

Table 5.15.5 Bay of Biscay (FU23 and 24): Males - LCA output

COHORT ANALYSIS
L INFINITY = 76.0000 K = .1400
COHORT ANALYSIS BY EXACT CALCULATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
13.0	33.6	.3000	.1143	.0001	.0008	.3008	354778.1	39857.7	61099.6
14.0	45.0	.3000	.1161	.0001	.0012	.3012	342787.2	39125.2	75278.6
15.0	226.2	.3000	.1181	.0007	.0059	.3059	331004.5	38383.2	91297.8
16.0	537.8	.3000	.1201	.0017	.0143	.3143	319263.4	37613.8	109146.9
17.0	1017.9	.3000	.1221	.0034	.0277	.3277	307441.5	36798.5	128752.4
18.0	3157.8	.3000	.1242	.0110	.0882	.3882	295384.0	35824.1	149570.4
19.0	2800.6	.3000	.1264	.0102	.0806	.3806	281478.7	34743.6	171494.3
20.0	7050.9	.3000	.1287	.0272	.2110	.5110	268254.8	33414.4	193364.0
21.0	6354.6	.3000	.1311	.0261	.1994	.4994	251178.5	31866.5	214562.2
22.0	10279.4	.3000	.1335	.0456	.3415	.6415	235262.9	30103.6	234219.7
23.0	8515.4	.3000	.1361	.0411	.3019	.6019	215950.3	28210.9	252044.3
24.0	11683.6	.3000	.1387	.0618	.4456	.7456	198969.8	26218.2	267433.5
25.0	17117.7	.3000	.1414	.1025	.7245	1.0245	179420.7	23625.3	273678.4
26.0	14802.2	.3000	.1443	.1025	.7102	1.0102	155215.4	20842.3	272855.1
27.0	12938.5	.3000	.1473	.1037	.7044	1.0044	134160.5	18367.2	270511.9
28.0	12896.8	.3000	.1504	.1210	.8044	1.1044	115711.8	16032.7	264532.1
29.0	10402.9	.3000	.1536	.1149	.7481	1.0481	98005.2	13905.7	256029.8
30.0	10433.0	.3000	.1570	.1369	.8721	1.1721	83430.6	11963.6	244905.8
31.0	7961.0	.3000	.1605	.1249	.7782	1.0782	69408.5	10230.7	232057.8
32.0	7232.3	.3000	.1642	.1357	.8264	1.1264	58378.3	8752.0	219261.6
33.0	5796.1	.3000	.1681	.1306	.7770	1.0770	48520.4	7459.6	205788.1
34.0	4909.2	.3000	.1721	.1328	.7714	1.0714	40486.4	6363.9	192775.8
35.0	4209.9	.3000	.1764	.1373	.7785	1.0785	33668.0	5407.6	179388.9
36.0	3432.0	.3000	.1808	.1354	.7485	1.0485	27835.9	4585.5	166164.7
37.0	3130.6	.3000	.1855	.1504	.8108	1.1108	23028.3	3861.1	152474.0
38.0	2351.1	.3000	.1905	.1381	.7250	1.0250	18739.3	3242.7	139232.3
39.0	1948.6	.3000	.1957	.1393	.7120	1.0120	15415.4	2736.9	127499.4
40.0	1729.1	.3000	.2012	.1517	.7541	1.0541	12645.7	2292.8	115648.7
41.0	1267.2	.3000	.2071	.1366	.6597	.9597	10228.7	1920.7	104695.1
42.0	1105.7	.3000	.2132	.1462	.6856	.9856	8385.3	1612.6	94815.9
43.0	943.4	.3000	.2198	.1547	.7038	1.0038	6795.9	1340.4	84858.9
44.0	725.3	.3000	.2268	.1480	.6525	.9525	5450.3	1111.6	75650.4
45.0	618.0	.3000	.2342	.1573	.6718	.9718	4391.5	919.9	67186.7
46.0	469.1	.3000	.2422	.1496	.6177	.9177	3497.6	759.5	59438.1
47.0	372.8	.3000	.2507	.1486	.5928	.8928	2800.7	629.0	52673.9
48.0	375.2	.3000	.2598	.1911	.7358	1.0358	2239.1	510.0	45631.7
49.0	196.0	.3000	.2696	.1269	.4707	.7707	1710.9	416.5	39762.4
50.0	208.4	.3000	.2801	.1697	.6059	.9059	1389.9	343.9	34991.7
51.0	126.4	.3000	.2916	.1305	.4474	.7474	1078.4	282.5	30597.6
52.0	141.7	.3000	.3040	.1872	.6157	.9157	867.2	230.1	26492.6
53.0	84.5	.3000	.3175	.1448	.4561	.7561	656.5	185.3	22653.7
54.0	94.9	.3000	.3323	.2141	.6443	.9443	516.4	147.3	19095.9
55.0	58.9	.3000	.3485	.1792	.5143	.8143	377.3	114.5	15727.5
56.0	38.5	.3000	.3664	.1540	.4204	.7204	284.1	91.5	13301.9
57.0	30.4	.3000	.3862	.1593	.4126	.7126	218.2	73.7	11325.4
58.0	29.1	.3000	.4083	.2064	.5056	.8056	165.7	57.6	9363.0
59.0	9.6	.3000	.4330	.0892	.2061	.5061	119.3	46.4	7948.6
60.0	20.9	.3000	.4610	.2654	.5757	.8757	95.8	36.3	6566.1
61.0	40.0	.3000			.5000	.8000	64.0	36.3	6917.5
				TOTAL BIOMASS INCLUDES LENGTHS ABOVE +GP			582876.3		6130656.0

Table 5.15.6 Bay of Biscay (FU23 and 24): Females - LCA output

COHORT ANALYSIS
LOWER CURVE LINF= 76.0000 K= .1400
UPPER CURVE LINF= 56.0000 K= .1100
TRANSITION LENGTH= 25.0000

COHORT ANALYSIS BY EXACT CALCULATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
11.0	85.0	.3000	.2232	.0003	.0014	.3014	285408.1	61616.4	80047.9
13.0	35.3	.3000	.1143	.0001	.0012	.3012	266838.1	29977.5	61557.5
14.0	130.4	.3000	.1161	.0005	.0044	.3044	257809.6	29420.5	74152.5
15.0	698.1	.3000	.1181	.0029	.0242	.3242	248853.0	28825.9	88004.5
16.0	1128.2	.3000	.1201	.0048	.0400	.3400	239507.1	28174.1	102983.7
17.0	2464.7	.3000	.1221	.0110	.0899	.3899	229926.7	27416.9	118758.1
18.0	4238.7	.3000	.1242	.0199	.1601	.4601	219236.7	26471.4	134635.5
19.0	6270.6	.3000	.1264	.0314	.2480	.5480	207056.1	25291.1	149799.8
20.0	8499.5	.3000	.1287	.0459	.3565	.6565	193197.2	23843.6	163248.0
21.0	6940.1	.3000	.1311	.0407	.3104	.6104	177542.8	22363.3	175798.9
22.0	9602.7	.3000	.1335	.0616	.4615	.7615	163892.3	20806.5	186644.7
23.0	9640.3	.3000	.1361	.0687	.5053	.8053	148047.7	19078.8	194206.6
24.0	12428.5	.3000	.1387	.1005	.7245	1.0245	132683.8	17155.7	197139.8
25.0	13830.4	.2000	.1414	.1299	.9184	1.1184	115108.6	15059.2	194428.2
26.0	12456.0	.2000	.3082	.1400	.4541	.6541	98266.3	27427.7	396118.0
27.0	12054.0	.2000	.3190	.1681	.5271	.7271	80324.8	22869.9	367966.5
28.0	11717.3	.2000	.3306	.2106	.6369	.8369	63696.9	18396.7	328509.0
29.0	8103.2	.2000	.3431	.1904	.5551	.7551	48300.2	14599.0	288308.8
30.0	6911.0	.2000	.3566	.2130	.5974	.7974	37277.2	11568.8	251836.9
31.0	4106.1	.2000	.3711	.1645	.4434	.6434	28052.4	9260.9	221531.6
32.0	3523.0	.2000	.3869	.1809	.4676	.6676	22094.1	7533.5	197454.7
33.0	2356.2	.2000	.4041	.1550	.3835	.5835	17064.4	6143.1	175940.1
34.0	2044.2	.2000	.4229	.1719	.4065	.6065	13479.7	5028.2	156957.6
35.0	1380.2	.2000	.4435	.1487	.3352	.5352	10429.8	4118.0	139763.8
36.0	1029.9	.2000	.4663	.1404	.3011	.5011	8226.0	3420.6	125936.1
37.0	755.4	.2000	.4915	.1297	.2639	.4639	6512.0	2862.0	114056.1
38.0	618.3	.2000	.5196	.1340	.2579	.4579	5184.1	2397.3	103197.3
39.0	443.5	.2000	.5511	.1216	.2206	.4206	4086.4	2010.2	93290.2
40.0	395.4	.2000	.5867	.1383	.2357	.4357	3240.9	1677.9	83796.0
41.0	215.9	.2000	.6272	.0959	.1529	.3529	2509.9	1412.2	75758.2
42.0	211.6	.2000	.6737	.1191	.1768	.3768	2011.6	1196.9	68856.1
43.0	175.0	.2000	.7277	.1282	.1762	.3762	1560.6	993.5	61191.2
44.0	91.1	.2000	.7910	.0865	.1093	.3093	1186.9	832.8	54838.8
45.0	619.5	.2000			.4000	.6000	929.3	832.8	58538.0
				TOTAL BIOMASS INCLUDES LENGTHS ABOVE +GP				535906.8	7328611.0

Table 5.15.7 Bay of Biscay (FU23 and 24): Males - VPA input

Catch numbers at age Numbers*10**-3

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	40865	45008	35207	63603	75018	51336	28528	1771	26112	23537	22943
2	121835	87440	153793	182589	120679	71634	55972	113376	106715	80272	
3	45429	41829	42088	68538	77528	51612	49423	47221	63341	54948	45538
4	16316	11158	14221	19874	23254	19384	25981	19451	20283	14539	13903
5	4111	3881	3925	6516	7341	5743	8220	7434	6733	4639	3347
6	694	1552	1014	2133	2106	2828	3214	2669	2434	1708	1065
+gp	257	968	559	1475	1349	2052	1688	1489	1072	1267	839
TOTALNUM	202867	226230	184455	315931	369185	253634	188688	136006	233350	207352	167906
TONSLAND	2679	2770	2526	4181	4769	3595	3564	3183	3664	3079	2351
SOPCOF %	85	83	86	84	87	88	90	98	86	86	81

Catch weights at age (kg)

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0050
2	.0110	.0110	.0110	.0110	.0100	.0100	.0110	.0120	.0110	.0110	.0110
3	.0220	.0220	.0220	.0220	.0220	.0220	.0230	.0220	.0220	.0220	.0220
4	.0370	.0380	.0370	.0370	.0370	.0370	.0380	.0380	.0380	.0370	.0370
5	.0560	.0570	.0560	.0570	.0570	.0570	.0570	.0570	.0570	.0570	.0560
6	.0780	.0780	.0780	.0780	.0780	.0780	.0790	.0780	.0780	.0780	.0790
+gp	.0990	.0990	.0990	.1180	.1210	.1190	.1100	.1120	.1160	.1290	.1190
SOPCOFAC	.8465	.8274	.8580	.8421	.8650	.8751	.8994	.9772	.8642	.8554	.8148

Stock weights at age (kg)

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0050
2	.0110	.0110	.0110	.0110	.0100	.0100	.0110	.0120	.0110	.0110	.0110
3	.0220	.0220	.0220	.0220	.0220	.0220	.0230	.0220	.0220	.0220	.0220
4	.0370	.0380	.0370	.0370	.0370	.0370	.0380	.0380	.0380	.0370	.0370
5	.0560	.0570	.0560	.0570	.0570	.0570	.0570	.0570	.0570	.0570	.0560
6	.0780	.0780	.0780	.0780	.0780	.0780	.0790	.0780	.0780	.0780	.0790
+gp	.0990	.0990	.0990	.1180	.1210	.1190	.1100	.1120	.1160	.1290	.1190

Natural Mortality (M) at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000
2	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000
3	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000
4	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000
5	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000
6	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000
+gp	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	

Proportion mature at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Proportion of M before Spawning

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
+gp	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Proportion of F before Spawning

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
+gp	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Table 5.15.8 Bay of Biscay (FU23 and 24): Males - VPA tuning information

```
Extended Survivors Analysis
  bay of biscay males INDEX FILE
 CPUE data from file  TUNEFF.DAT

 Catch data for  11 years. 1984 to 1994. Ages  1 to   7.

      Fleet             First  Last  First  Last  Alpha   Beta
                         year  year   age    age
  FLEET 1                1984  1994    1      6    .000   1.000

 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years

 Catchability analysis :

      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=    5

 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final   5 years or the   5 oldest ages.

      S.E. of the mean to which the estimates  are shrunk =    .500

      Minimum standard error for population
      estimates derived from each fleet =    .300

      Prior weighting not applied


 Tuning converged after   18 iterations

 Regression weights
          .751   .820   .877   .921   .954   .976   .990   .997  1.000  1.000

 Fishing mortalities
    Age   1985   1986   1987   1988   1989   1990   1991   1992   1993   1994

      1   .122   .076   .132   .200   .180   .108   .006   .081   .079   .086
      2   .662   .417   .622   .796   .658   .465   .359   .653   .625   .475
      3   .703   .576   .793   .885   .624   .722   .750  1.080   .924   .694
      4   .613   .631   .687   .808   .655   .889   .826  1.042   .924   .732
      5   .738   .514   .786   .678   .535   .754   .807   .917   .836   .638
      6   .583   .487   .680   .737   .702   .764   .679   .795   .722   .519

XSA population numbers (Thousands)
                                AGE
 YEAR              1          2          3          4          5          6

 1985       4.54E+05   2.92E+05   9.62E+04   2.83E+04   8.64E+03   4.08E+03
 1986       5.62E+05   2.98E+05   1.12E+05   3.53E+04   1.13E+04   3.06E+03
 1987       5.96E+05   3.86E+05   1.45E+05   4.65E+04   1.39E+04   5.03E+03
 1988       4.80E+05   3.86E+05   1.53E+05   4.88E+04   1.73E+04   4.69E+03
 1989       3.62E+05   2.91E+05   1.29E+05   4.69E+04   1.61E+04   6.52E+03
 1990       3.24E+05   2.24E+05   1.12E+05   5.12E+04   1.80E+04   6.99E+03
 1991       3.73E+05   2.15E+05   1.04E+05   4.02E+04   1.56E+04   6.29E+03
 1992       3.90E+05   2.75E+05   1.11E+05   3.64E+04   1.30E+04   5.16E+03
 1993       3.60E+05   2.67E+05   1.06E+05   2.80E+04   9.52E+03   3.86E+03
 1994       3.25E+05   2.47E+05   1.06E+05   3.11E+04   8.24E+03   3.06E+03

 Estimated population abundance at 1st Jan 1995

           0.00E+00   2.21E+05   1.14E+05   3.91E+04   1.11E+04   3.22E+03

 Taper weighted geometric mean of the VPA populations:

           4.10E+05   2.78E+05   1.14E+05   3.79E+04   1.26E+04   4.43E+03
```

Tables 5.15.8 cont'd. Bay of Biscay (FU23 and 24): Males - VPA tuning information

Standard error of the weighted Log(VPA populations) :

.2085	.1956	.1583	.2269	.2863	.3842

Log catchability residuals.

Fleet : FLEET 1

Age	1984
1	.61
2	.38
3	.40
4	.48
5	.16
6	.11

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.49	.08	.49	.70	.65	.20	-2.77	-.18	-.14	.33
2	.26	-.13	.11	.16	.03	-.26	-.51	-.02	.02	.13
3	.00	-.13	.03	-.05	-.34	-.14	-.11	.16	.08	.19
4	-.15	-.06	-.13	-.16	-.31	.04	-.03	.10	.06	.22
5	.14	-.15	.12	-.22	-.40	-.01	.06	.09	.07	.19
6	-.09	-.21	-.03	-.14	-.13	.00	-.11	-.05	-.07	-.01

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6
Mean Log q	-15.8523	-13.9468	-13.6276	-13.6084	-13.7175	-13.7175
S.E(Log q)	1.0195	.2460	.1924	.2039	.1885	.1094

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	.47	.664	14.31	.17	11	.50	-15.85
2	.61	1.646	13.40	.69	11	.14	-13.95
3	2.09	-1.339	15.79	.16	11	.39	-13.63
4	1.84	-1.664	16.19	.33	11	.34	-13.61
5	1.65	-2.120	16.52	.57	11	.26	-13.72
6	1.07	-.982	14.19	.96	11	.09	-13.79

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEET 1	308462.	1.069	.000	.00	1	.167	.062
F shrinkage mean	206693.	.50				.833	.091

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
220995.	.45	.37	2	.806	.086

Tables 5.15.8 cont'd. Bay of Biscay (FU23 and 24): Males - VPA tuning information

```
Age  2   Catchability constant w.r.t. time and dependent on age
 Year class = 1992

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
  FLEET 1                 127363.    .289        .067     .23    2   .650      .433

   F shrinkage mean        92114.     .50                             .350      .560

 Weighted prediction :
 Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
    113691.         .26       .14     3     .549     .475

Age  3   Catchability constant w.r.t. time and dependent on age
 Year class = 1991

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
  FLEET 1                  44071.    .218        .067     .31    3   .686      .636

   F shrinkage mean        30119.     .50                             .314      .833

 Weighted prediction :
 Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
     39104.         .22       .13     4     .605     .694

Age  4   Catchability constant w.r.t. time and dependent on age
 Year class = 1990

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
  FLEET 1                  12582.    .203        .175     .86    4   .684      .668

   F shrinkage mean         8456.     .50                             .316      .882

 Weighted prediction :
 Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
     11096.         .21       .17     5     .796     .732

 Age  5   Catchability constant w.r.t. time and dependent on age
 Year class = 1989

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
  FLEET 1                   3630.    .200        .082     .41    5   .705      .584

   F shrinkage mean         2430.     .50                             .295      .782

 Weighted prediction :
 Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
      3225.         .20       .12     6     .566     .638

Age  6   Catchability constant w.r.t. time and age (fixed at the value for age)  5
 Year class = 1988

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
  FLEET 1                   1363.    .194        .032     .16    6   .738      .514

   F shrinkage mean         1306.     .50                             .262      .532

 Weighted prediction :
 Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
      1348.         .19       .03     7     .137     .519
```

Table 5.15.9 Bay of Biscay (FU23 and 24): Males - VPA output

Terminal Fs derived using XSA (With F shrinkage)

Fishing mortality (F) at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94
AGE												
1	.1136	.1222	.0756	.1325	.2004	.1803	.1079	.0055	.0809	.0789	.0856	.0818
2	.6159	.6624	.4170	.6223	.7962	.6576	.4655	.3594	.6533	.6254	.4748	.5845
3	.8683	.7032	.5763	.7929	.8852	.6243	.7220	.7496	1.0804	.9239	.6943	.8996
4	.9655	.6133	.6314	.6868	.8076	.6548	.8895	.8263	1.0418	.9236	.7316	.8990
5	.6241	.7383	.5141	.7862	.6779	.5348	.7537	.8070	.9172	.8356	.6383	.7970
6	.5928	.5826	.4867	.6795	.7370	.7019	.7641	.6791	.7953	.7222	.5187	.6788
+gp	.5928	.5826	.4867	.6795	.7370	.7019	.7641	.6791	.7953	.7222	.5187	
0 FBAR 1- 6	.6300	.5703	.4502	.6167	.6841	.5590	.6171	.5712	.7615	.6849	.5239	

Terminal Fs derived using XSA (With F shrinkage)

Stock number at age (start of year) Numbers*10**-3

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 84-92	AMST 84-92
AGE														
1	441966	454456	561521	595538	479891	361514	323927	372762	390284	360398	324968	0	434253	442429
2	240504	292243	297930	385682	386442	290944	223631	215416	274625	266655	246731	220995	283985	289713
3	90953	96236	111635	145452	153349	129128	111667	104014	111409	105864	105693	113691	115443	117094
4	30613	28278	35291	46475	48762	46875	51237	40186	36412	28016	31132	39104	39670	40459
5	10288	8636	11345	13904	17324	16109	18042	15596	13029	9517	8241	11096	13443	13808
6	1804	4083	3057	5026	4693	6515	6990	6290	5155	3857	3057	3225	4518	4846
+gp	657	2500	1659	3404	2940	4628	3590	3438	2218	2801	2369	2393		
TOTAL	816784	886432	1022438	1195482	1093402	855713	739084	757703	833132	777107	722191	390504		

Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 1- 6
1984	441966	8771	8771	2679	.3054	.6300
1985	454456	9737	9737	2770	.2844	.5703
1986	561521	10885	10885	2526	.2321	.4502
1987	595538	13726	13726	4181	.3046	.6167
1988	479891	13151	13151	4769	.3626	.6841
1989	361514	11269	11269	3595	.3190	.5590
1990	323927	10570	10570	3564	.3372	.6171
1991	372762	10029	10029	3183	.3174	.5712
1992	390284	10209	10209	3664	.3589	.7615
1993	360398	9305	9305	3079	.3309	.6849
1994	324968	8801	8801	2351	.2671	.5239
Arith. Mean	424293	10587	10587	3305	.3109	.6063
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 5.15.10 Bay of Biscay (FU23 and 24): Female - VPA input

Catch numbers at age Numbers*10**-3

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	38743	35444	31815	20476	18689	22171	23326	10303	15059	13613	8425
2	170298	166373	138804	112765	128176	121986	89057	69669	93142	85575	51678
3	36090	28435	31738	24665	32462	23207	23919	29812	45011	28343	27630
4	17557	13556	16276	8321	12448	9530	10787	14139	15735	15155	10823
5	6554	5425	7159	2818	4548	4829	6385	5102	6827	7519	3823
6	2305	2263	2696	1186	1813	2517	2545	2114	2133	4009	1773
7	937	1166	1107	757	1152	1470	1362	1162	1306	1808	843
8	373	565	524	430	704	861	706	657	696	1035	541
9	182	260	238	161	313	464	353	300	361	443	276
+gp	367	623	573	774	772	1749	720	819	1175	1071	897
TOTALNUM	273405	254110	230930	172351	201076	188783	159160	134076	181444	158569	106707
TONSLAND	3013	2762	2672	1930	2424	2271	1969	1895	2549	1828	1260
SOPCOF %	98	98	98	100	100	100	99	99	99	81	80

Catch weights at age (kg)

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0040	.0040	.0040	.0040
2	.0090	.0090	.0090	.0090	.0090	.0090	.0090	.0100	.0100	.0100	.0100
3	.0170	.0170	.0170	.0160	.0170	.0160	.0170	.0170	.0170	.0160	.0170
4	.0220	.0220	.0220	.0220	.0220	.0220	.0220	.0220	.0220	.0220	.0220
5	.0280	.0280	.0280	.0280	.0280	.0280	.0280	.0280	.0280	.0280	.0280
6	.0340	.0340	.0340	.0340	.0340	.0340	.0340	.0340	.0340	.0340	.0340
7	.0400	.0400	.0400	.0400	.0400	.0400	.0400	.0400	.0410	.0400	.0400
8	.0460	.0460	.0460	.0470	.0460	.0470	.0460	.0460	.0460	.0470	.0470
9	.0530	.0520	.0530	.0530	.0530	.0520	.0520	.0520	.0530	.0530	.0530
+gp	.0690	.0710	.0710	.0790	.0750	.0760	.0680	.0740	.0810	.0750	.0790
SOPCOFAC	.9789	.9811	.9824	.9977	1.0040	1.0019	.9934	.9854	.9933	.8058	.8024

Stock weights at age (kg)

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.0050	.0050	.0050	.0050	.0050	.0050	.0050	.0040	.0040	.0040	.0040
2	.0090	.0090	.0090	.0090	.0090	.0090	.0090	.0100	.0100	.0100	.0100
3	.0170	.0170	.0170	.0160	.0170	.0160	.0170	.0170	.0170	.0160	.0170
4	.0220	.0220	.0220	.0220	.0220	.0220	.0220	.0220	.0220	.0220	.0220
5	.0280	.0280	.0280	.0280	.0280	.0280	.0280	.0280	.0280	.0280	.0280
6	.0340	.0340	.0340	.0340	.0340	.0340	.0340	.0340	.0340	.0340	.0340
7	.0400	.0400	.0400	.0400	.0400	.0400	.0400	.0400	.0410	.0400	.0400
8	.0460	.0460	.0460	.0470	.0460	.0470	.0460	.0460	.0460	.0470	.0470
9	.0530	.0520	.0530	.0530	.0530	.0520	.0520	.0520	.0530	.0530	.0530
+gp	.0690	.0710	.0710	.0790	.0750	.0760	.0680	.0740	.0810	.0750	.0790

Natural Mortality (M) at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000
2	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000	.3000
3	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
4	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
5	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
6	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
7	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
8	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
9	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000
+gp	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000	.2000

Proportion mature at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Proportion of M before Spawning

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
7	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
8	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
9	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
+gp	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Proportion of F before Spawning

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
7	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
8	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
9	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
+gp	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Table 5.15.11 Bay of Biscay (FU23 and 24): Females - VPA tuning information

```
Extended Survivors Analysis
Bay of Biscay Nephrops females (23-24) 94   index file
CPUE data from file c:\wgnep95\golfe\lowestof\bbfef94.dat 11

Catch data for  11 years. 1984 to 1994. Ages  1 to  10.

     Fleet             First  Last  First  Last  Alpha   Beta
                        year  year   age    age
Flt01 : France          1984  1994    1      9    .000   1.000

Time series weights :

     Tapered time weighting applied
     Power =    3 over  20 years

Catchability analysis :

     Catchability dependent on stock size for ages <    3

        Regression type = C
        Minimum of    5 points used for regression
        Survivor estimates shrunk to the population mean for ages <  3

     Catchability independent of age for ages >=    7

Terminal population estimation :

     Survivor estimates shrunk towards the mean F
     of the final    5 years or the    5 oldest ages.

     S.E. of the mean to which the estimates  are shrunk =    .500

     Minimum standard error for population
     estimates derived from each fleet =    .300

     Prior weighting not applied

Tuning converged after   24 iterations

Regression weights
         .751   .820   .877   .921   .954   .976   .990   .997  1.000  1.000

Fishing mortalities
   Age   1985   1986   1987   1988   1989   1990   1991   1992   1993   1994

     1   .115   .113   .073   .066   .089   .097   .045   .067   .074   .039
     2  1.140  1.040   .850  1.028   .914   .697   .533   .824   .763   .496
     3   .593   .736   .540   .683   .541   .472   .568   .876   .694   .644
     4   .590   .833   .428   .582   .433   .523   .572   .679   .857   .629
     5   .517   .731   .322   .441   .469   .586   .505   .608   .838   .542
     6   .504   .529   .246   .354   .470   .486   .389   .409   .916   .475
     7   .575   .497   .273   .401   .546   .505   .430   .445   .741   .486
     8   .524   .556   .364   .442   .599   .555   .490   .498   .782   .513
     9   .466   .438   .327   .495   .593   .528   .486   .552   .698   .487

XSA population numbers (Thousands)

                              AGE
YEAR             1         2         3         4         5         6         7         8         9

1985      3.78E+05  2.84E+05  7.03E+04  3.36E+04  1.48E+04  6.32E+03  2.95E+03  1.53E+03  7.70E+02
1986      3.46E+05  2.49E+05  6.73E+04  3.18E+04  1.53E+04  7.25E+03  3.12E+03  1.36E+03  7.42E+02
1987      3.37E+05  2.29E+05  6.53E+04  2.64E+04  1.13E+04  6.02E+03  3.49E+03  1.56E+03  6.37E+02
1988      3.41E+05  2.32E+05  7.25E+04  3.12E+04  1.41E+04  6.72E+03  3.85E+03  2.18E+03  8.85E+02
1989      3.04E+05  2.37E+05  6.14E+04  3.00E+04  1.43E+04  7.42E+03  3.86E+03  2.11E+03  1.15E+03
1990      2.92E+05  2.06E+05  7.02E+04  2.93E+04  1.59E+04  7.30E+03  3.79E+03  1.83E+03  9.50E+02
1991      2.72E+05  1.96E+05  7.60E+04  3.59E+04  1.42E+04  7.24E+03  3.68E+03  1.87E+03  8.61E+02
1992      2.69E+05  1.93E+05  8.53E+04  3.53E+04  1.66E+04  7.02E+03  4.02E+03  1.96E+03  9.40E+02
1993      2.23E+05  1.86E+05  6.26E+04  2.91E+04  1.46E+04  7.38E+03  3.82E+03  2.11E+03  9.74E+02
1994      2.59E+05  1.53E+05  6.43E+04  2.56E+04  1.01E+04  5.18E+03  2.42E+03  1.49E+03  7.90E+02

Estimated population abundance at 1st Jan 1995

         0.00E+00  1.84E+05  6.92E+04  2.77E+04  1.12E+04  4.81E+03  2.64E+03  1.22E+03  7.30E+02

Taper weighted geometric mean of the VPA populations:

         3.03E+05  2.16E+05  7.00E+04  3.10E+04  1.40E+04  6.71E+03  3.44E+03  1.76E+03  8.41E+02

Standard error of the weighted Log(VPA populations) :

            .1831     .1873     .1068     .1228     .1510     .1174     .1645     .1769     .1935
```

Table 5.15.11 cont'd. Bay of Biscay (FU23 and 24): Females - VPA tuning information

Log catchability residuals.

Fleet : Flt01 : France

Age	1984
1	.05
2	.04
3	.40
4	.51
5	.51
6	.47
7	.25
8	.06
9	.24

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.07	.14	-.05	-.17	.03	.11	-.13	-.01	.17	-.16
2	-.01	.07	.00	-.01	-.05	-.04	-.10	.03	.05	.03
3	.08	.35	-.10	-.06	-.24	-.32	-.14	.20	.04	-.03
4	.11	.51	-.29	-.18	-.42	-.18	-.09	-.02	.29	-.02
5	.08	.48	-.48	-.36	-.24	.03	-.12	-.03	.36	-.07
6	.23	.34	-.57	-.40	-.07	.02	-.20	-.25	.63	-.02
7	.33	.25	-.50	-.31	.05	.03	-.13	-.19	.39	-.03
8	.24	.36	-.21	-.21	.14	.12	.00	-.08	.44	.02
9	.12	.12	-.32	-.10	.13	.07	-.01	.02	.33	-.03

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	-6.9555	-6.9929	-7.0918	-7.2654	-7.2355	-7.2355	-7.2355
S.E(Log q)	.2223	.2986	.3175	.3692	.2769	.2276	.1804

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.37	2.630	11.32	.69	11	.13	-9.09
2	.36	6.724	10.28	.93	11	.05	-6.72

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	.54	1.262	8.89	.49	11	.12	-6.96
4	.54	1.076	8.55	.40	11	.16	-6.99
5	.53	1.299	8.24	.49	11	.16	-7.09
6	.63	.536	7.84	.21	11	.24	-7.27
7	1.76	-.750	6.54	.11	11	.50	-7.24
8	1.13	-.279	7.12	.35	11	.25	-7.16
9	.79	.869	7.09	.69	11	.14	-7.19

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 : France	156659.	.300	.000	.00	1	.247	.045
P shrinkage mean	215666.	.19				.660	.033
F shrinkage mean	93384.	.50				.093	.075

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
184408.	.15	.21	3	1.418	.039

Table 5.15.11 cont'd. Bay of Biscay (FU23 and 24): Females - VPA tuning information

```
Age  2   Catchability dependent on age and year class strength

 Year class = 1992

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
 Flt01 : France            76077.    .212        .071     .34    2   .125      .460

   P shrinkage mean        70006.     .11                             .837      .492

   F shrinkage mean        39226.     .50                             .038      .758

 Weighted prediction :

 Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
     69187.         .10       .09     4     .924    .496

 Age  3   Catchability constant w.r.t. time and dependent on age

 Year class = 1991

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
 Flt01 : France            27509.    .187        .025     .13    3   .735      .646

   F shrinkage mean        28144.     .50                             .265      .636

 Weighted prediction :

 Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
     27676.         .19       .02     4     .099    .644


 Age  4   Catchability constant w.r.t. time and dependent on age

 Year class = 1990

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
 Flt01 : France            11087.    .183        .029     .16    4   .732      .633

   F shrinkage mean        11441.     .50                             .268      .618

 Weighted prediction :

 Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
     11181.         .19       .02     5     .123    .629

Age  5   Catchability constant w.r.t. time and dependent on age

 Year class = 1989

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
 Flt01 : France             5104.    .193        .079     .41    5   .717      .517

   F shrinkage mean         4146.     .50                             .283      .607

 Weighted prediction :

 Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
      4813.         .20       .08     6     .393    .542

Age  6   Catchability constant w.r.t. time and dependent on age

 Year class = 1988

 Fleet                  Estimated     Int        Ext     Var     N  Scaled   Estimated
                        Survivors     s.e        s.e     Ratio      Weights     F
 Flt01 : France             2823.    .195        .079     .40    6   .706      .450

   F shrinkage mean         2248.     .50                             .294      .539

 Weighted prediction :

Survivors          Int       Ext     N     Var      F
 at end of year     s.e       s.e           Ratio
      2640.         .20       .08     7     .391    .475
```

Table 5.15.11 cont'd. Bay of Biscay (FU23 and 24): Females - VPA tuning information

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 : France	1274.	.194	.101	.52	7	.739	.469
F shrinkage mean	1071.	.50				.261	.538

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1218.	.19	.09	8	.448	.486

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1986

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 : France	770.	.171	.078	.46	8	.771	.492
F shrinkage mean	609.	.50				.229	.590

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
730.	.17	.08	9	.431	.513

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1985

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Flt01 : France	411.	.167	.083	.50	9	.780	.474
F shrinkage mean	354.	.50				.220	.533

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
397.	.17	.07	10	.427	.487

Table 5.15.12 Bay of Biscay (FU23 and 24): Females - VPA output

Terminal Fs derived using XSA (With F shrinkage)
Fishing mortality (F) at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94
AGE												
1	.1110	.1154	.1130	.0733	.0658	.0886	.0975	.0450	.0673	.0736	.0386	.0598
2	1.1267	1.1401	1.0398	.8499	1.0283	.9143	.6972	.5325	.8243	.7630	.4965	.6946
3	.6787	.5926	.7361	.5400	.6833	.5407	.4722	.5680	.8755	.6937	.6436	.7376
4	.7275	.5899	.8332	.4283	.5823	.4332	.5228	.5723	.6793	.8575	.6291	.7220
5	.6621	.5172	.7308	.3216	.4414	.4689	.5864	.5054	.6079	.8384	.5416	.6626
6	.5352	.5042	.5294	.2457	.3540	.4700	.4864	.3894	.4092	.9162	.4748	.6000
7	.4405	.5752	.4970	.2735	.4012	.5459	.5054	.4295	.4450	.7409	.4864	.5574
8	.3632	.5245	.5559	.3642	.4422	.5987	.5555	.4900	.4984	.7819	.5135	.5979
9	.4367	.4658	.4378	.3272	.4953	.5930	.5280	.4856	.5515	.6984	.4870	.5790
+gp	.4367	.4658	.4378	.3272	.4953	.5930	.5280	.4856	.5515	.6984	.4870	
FBAR 3- 7	.6088	.5558	.6653	.3618	.4924	.4917	.5146	.4929	.6034	.8093	.5551	

Terminal Fs derived using XSA (With F shrinkage)
Stock number at age (start of year) Numbers*10**-3

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 84-92	AMST 84-92
AGE														
1	428602	377907	345858	336710	340996	303961	291743	272135	268936	222930	258712	0	326136	329650
2	292737	284170	249453	228835	231817	236531	206097	196052	192734	186272	153434	184408	233048	235381
3	80950	70288	67320	65330	72467	61413	70232	76028	85274	62613	64339	69187	71799	72145
4	37539	33621	31818	26399	31170	29958	29282	35858	35272	29089	25618	27676	32147	32324
5	14959	14848	15260	11323	14085	14256	15905	14213	16565	14641	10104	11181	14529	14602
6	6146	6317	7248	6016	6721	7416	7303	7244	7020	7385	5183	4813	6806	6826
7	2905	2946	3124	3495	3853	3862	3795	3676	4018	3818	2419	2640	3496	3519
8	1353	1531	1357	1556	2177	2112	1832	1874	1959	2108	1490	1218	1725	1750
9	568	770	742	637	885	1145	950	861	940	974	790	730	816	833
+gp	1137	1830	1772	3042	2163	4273	1920	2330	3031	2324	2545	1678		
TOTAL	866896	794228	723951	683343	706333	664926	629058	610271	615749	532153	524633	303530		

Summary (without SOP correction)
Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 7
1984	428602	7894	3117	3013	.9666	.6088
1985	377907	7370	2923	2762	.9449	.5558
1986	345858	6845	2871	2672	.9307	.6653
1987	336710	6378	2635	1930	.7325	.3618
1988	340996	6795	3004	2424	.8070	.4924
1989	303961	6580	2931	2271	.7749	.4917
1990	291743	6261	2948	1969	.6678	.5146
1991	272135	6225	3176	1895	.5967	.4929
1992	268936	6481	3478	2549	.7329	.6034
1993	222930	5535	2781	1828	.6574	.8093
1994	258712	5095	2526	1260	.4988	.5551
Arith. Mean	313499	6496	2944	2234	.7555	.5592
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 5.15.13 Nephrops Landings (tonnes) by Functional Unit plus Other rectangles in Management Area N (VIIIab)

Year	FU 23	FU 24	Other	Total
1985	4281	312		4593
1986	3968	367	99	4434
1987	5074	473	114	5661
1988	6019	658	137	6814
1989	4600	630	142	5372
1990	4603	358	88	5049
1991	4352	401	55	4808
1992	5123	558	47	5728
1993	4404	512	49	4965
1994	NA	NA	27	3638

Table 5.15.14 Total Nephrops Landings (tonnes) by country in Management Area N (VIIIab)

Year	France	Spain	Belgium	Total
1985	4593	?	?	4593
1986	4335	99	0	4434
1987	5597	64	0	5661
1988	6745	69	0	6814
1989	5295	77	0	5372
1990	4961	87	1	5049
1991	4753	55	<1	4808
1992	5681	47	0	5728
1993	4916	49	0	4965
1994	3611	27	<1	3638

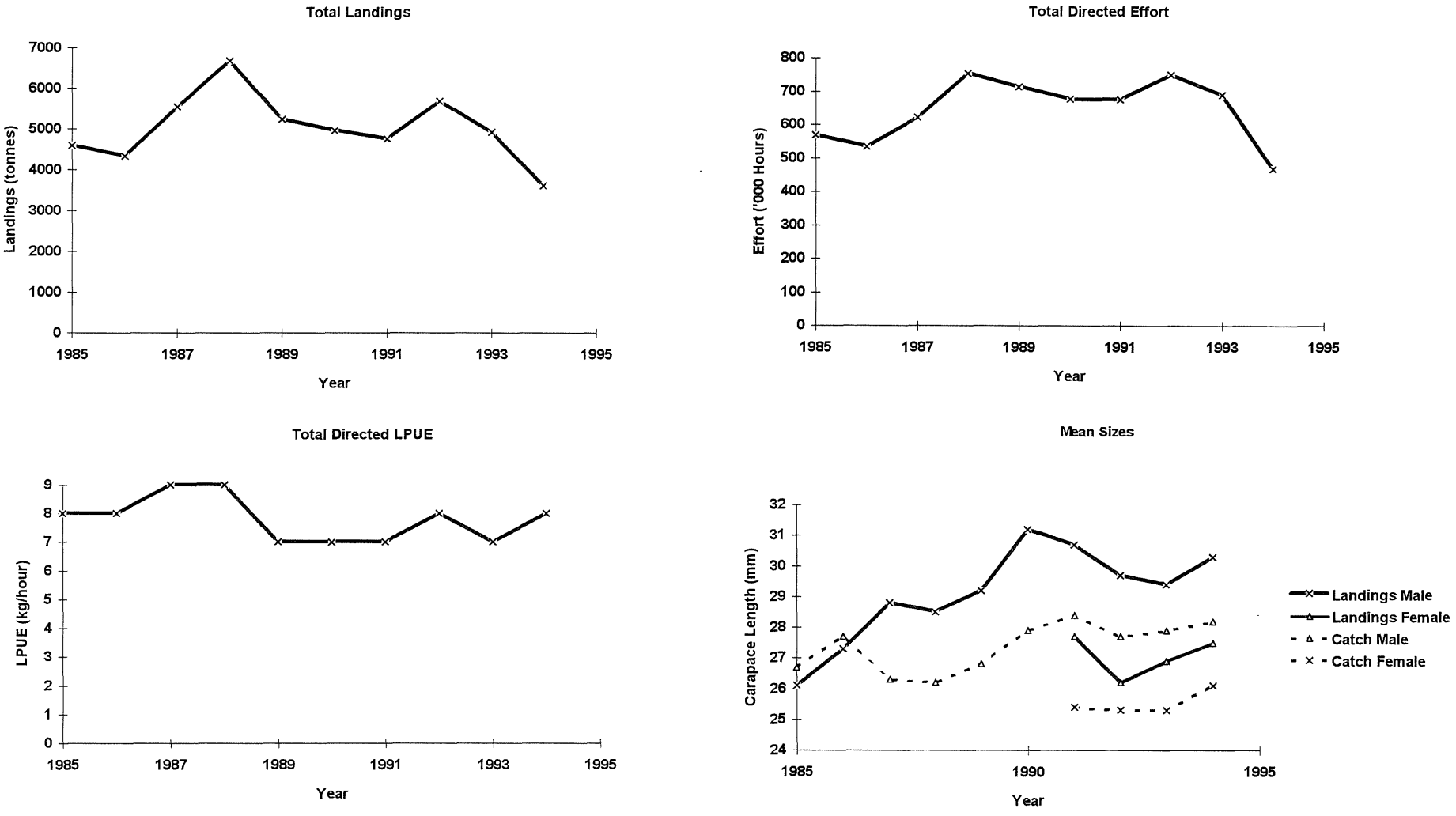


Figure 5.15.1 Bay of Biscay (FU's 23-24): Long term trends in French landings (tonnes), directed effort ('000 hours), LPUE (kg/hour) and mean sizes (mm CL) in landings and catch

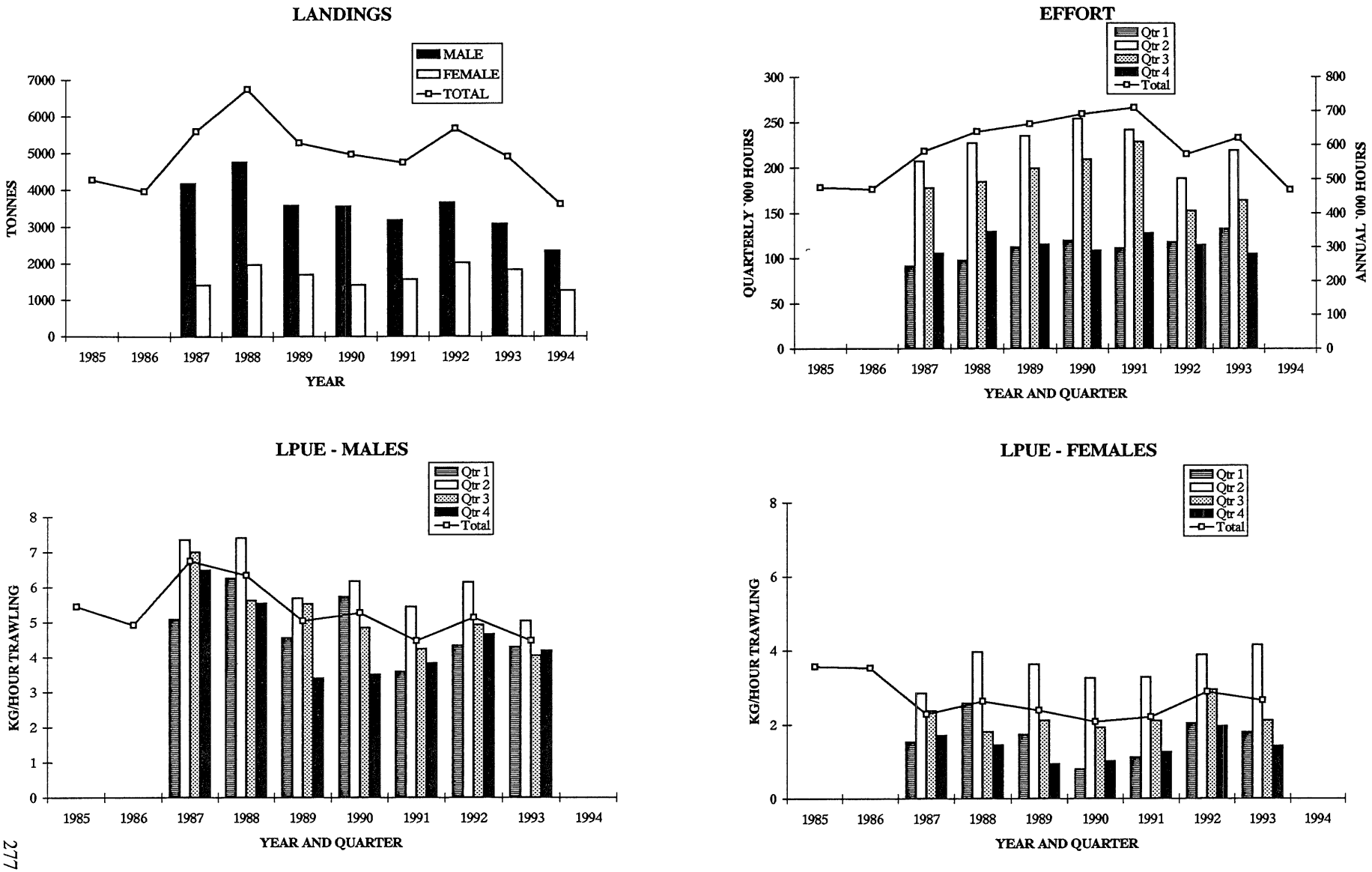


Figure 5.15.2. Bay of Biscay (functional unit 23-24) : trends in landings,effort and LPUE by quarter and sex from French Nephrops trawlers.

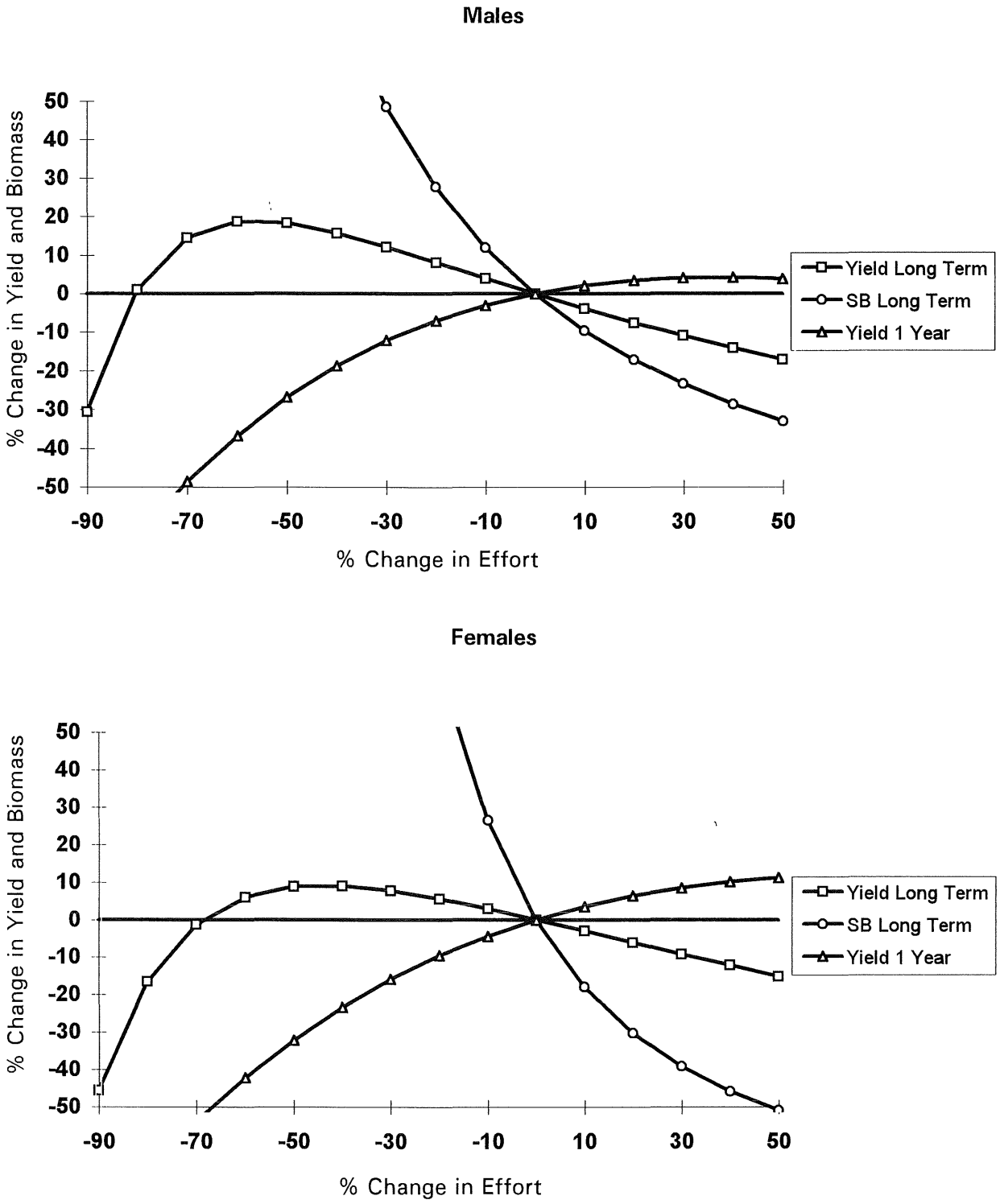


Figure 5.15.3 Bay of Biscay (FU's 23-24): Percentage changes in long term landings and stock biomass, and short term landings following various changes in fishing effort. Male and females shown separately

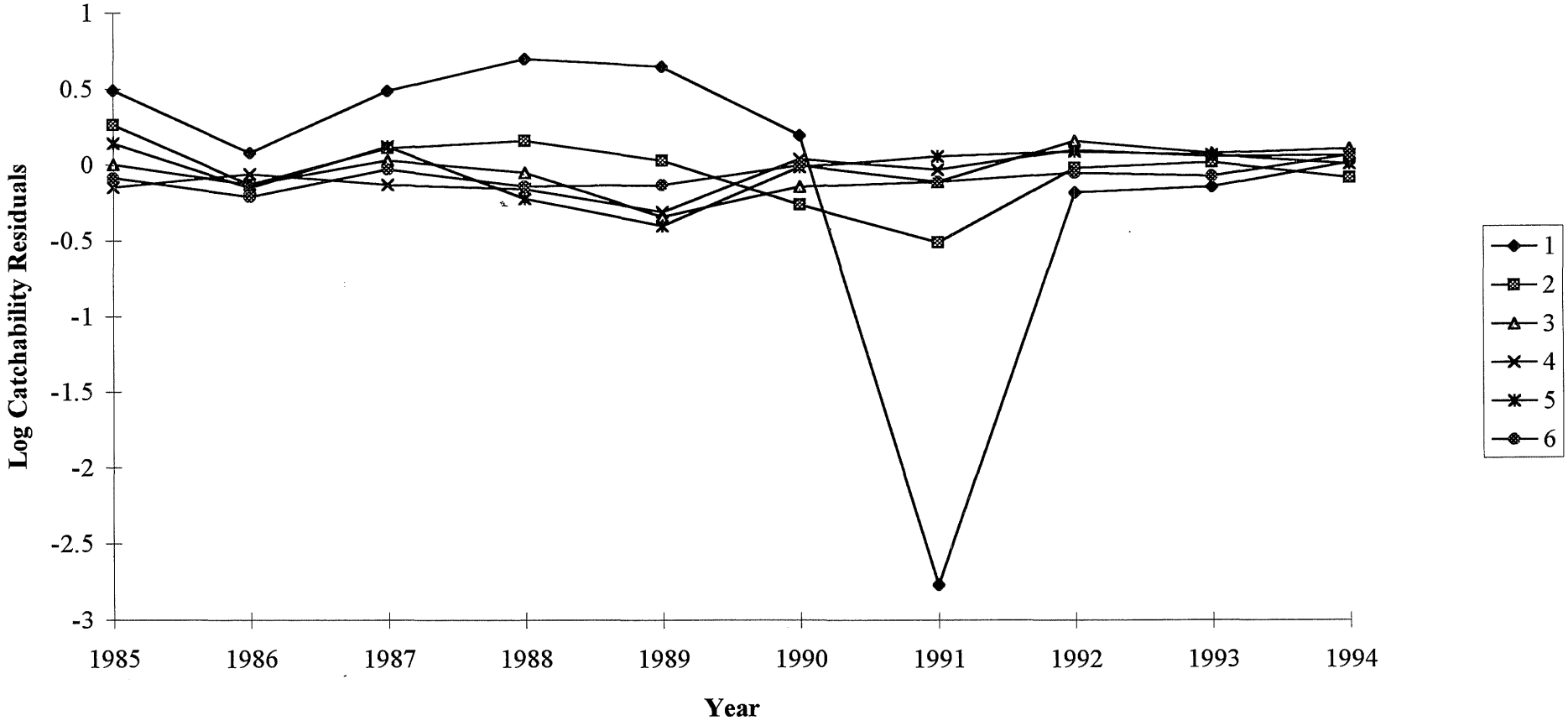
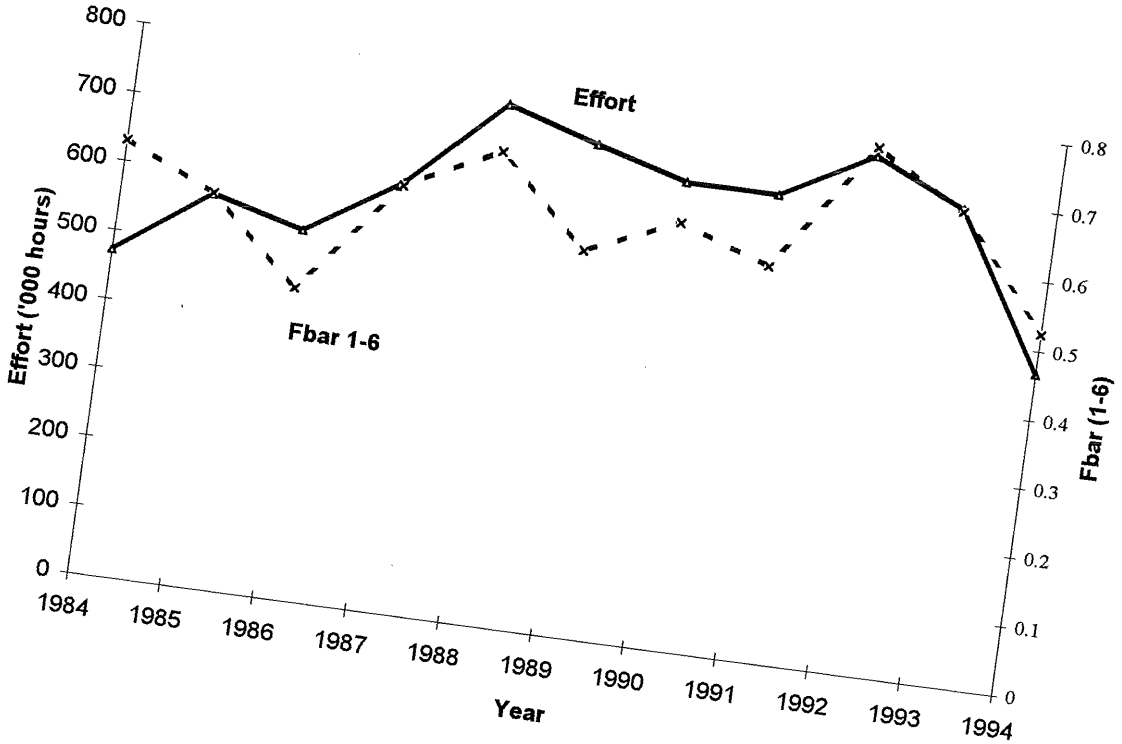


Figure 5.15.4 Bay of Biscay (FU's 23 and 24): Males - log catchability residuals from XSA



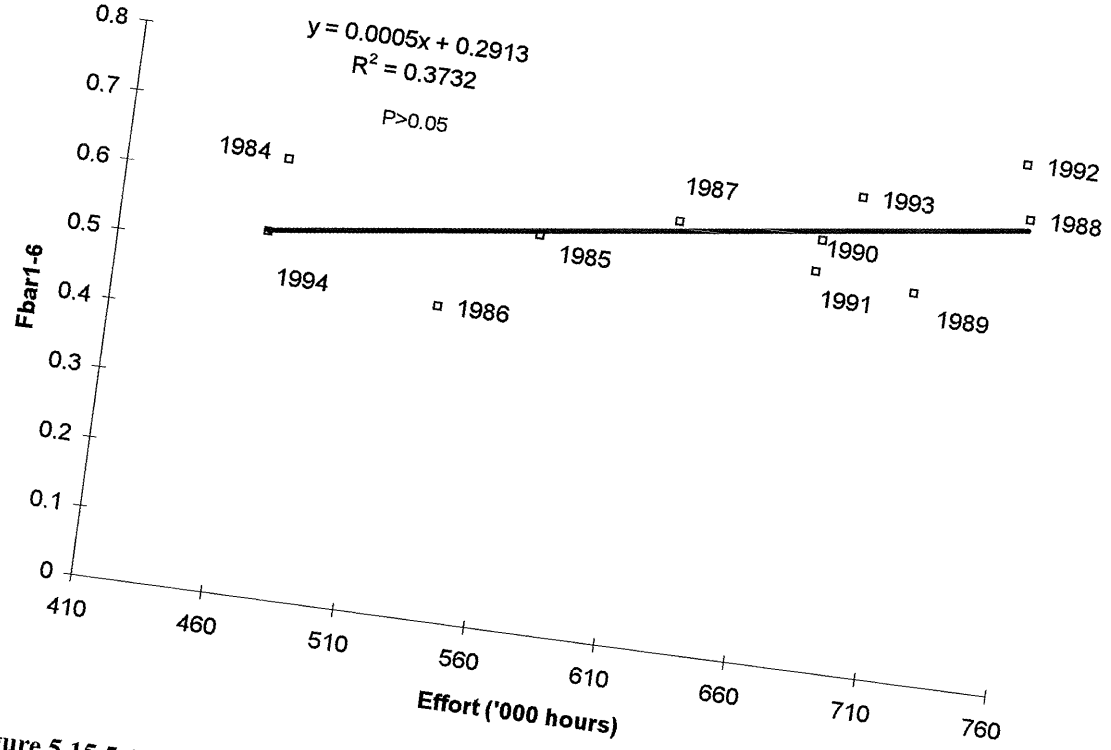


Figure 5.15.5 Bay of Biscay (FU's 23 24): Males - plot of effort and Fbar from XSA, together with their regression.

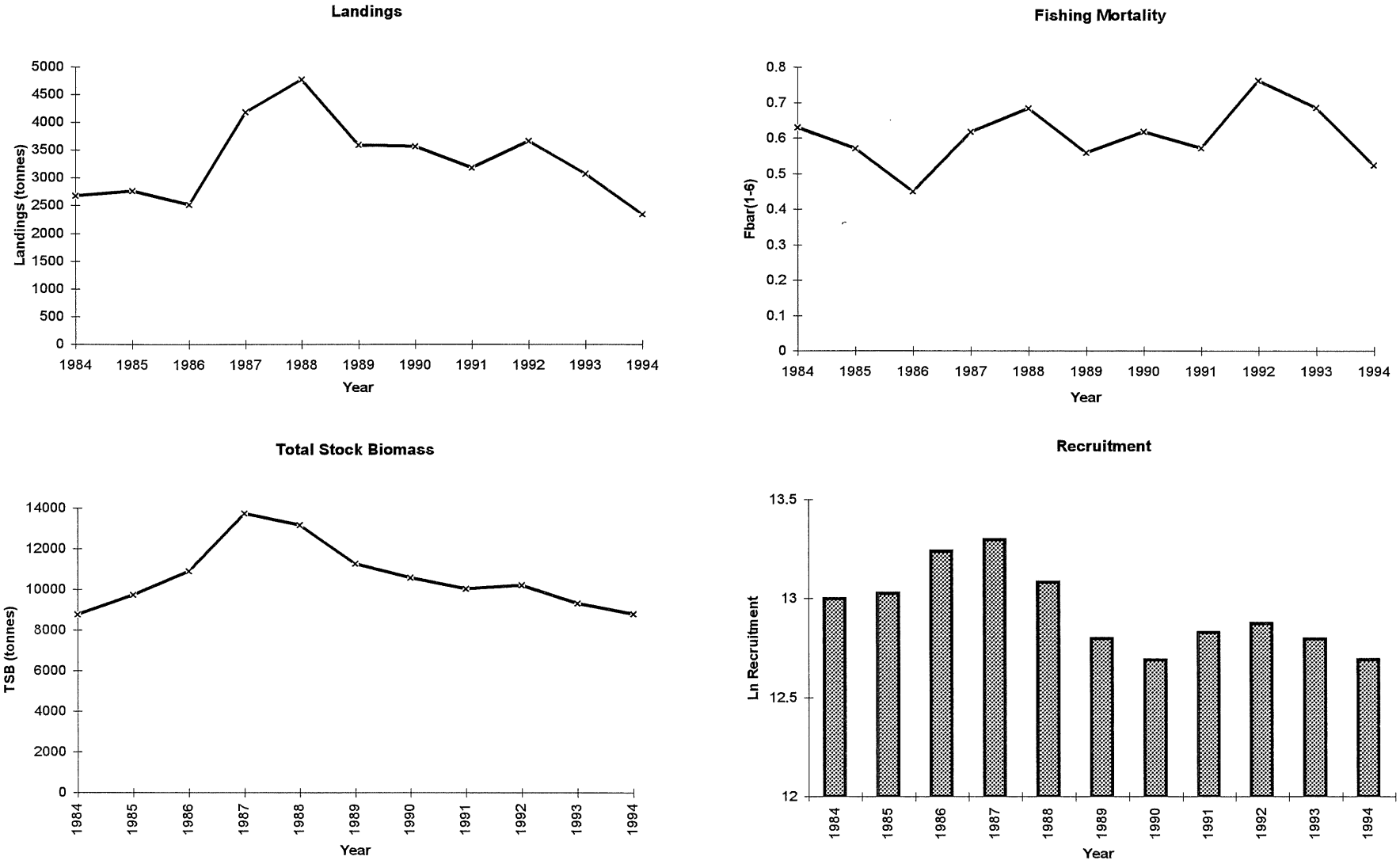


Figure 5.15.6 Bay of Biscay (FU's 23 24): Males - trends in landings, fishing mortality, total stock biomass, and Ln recruitment from XSA.

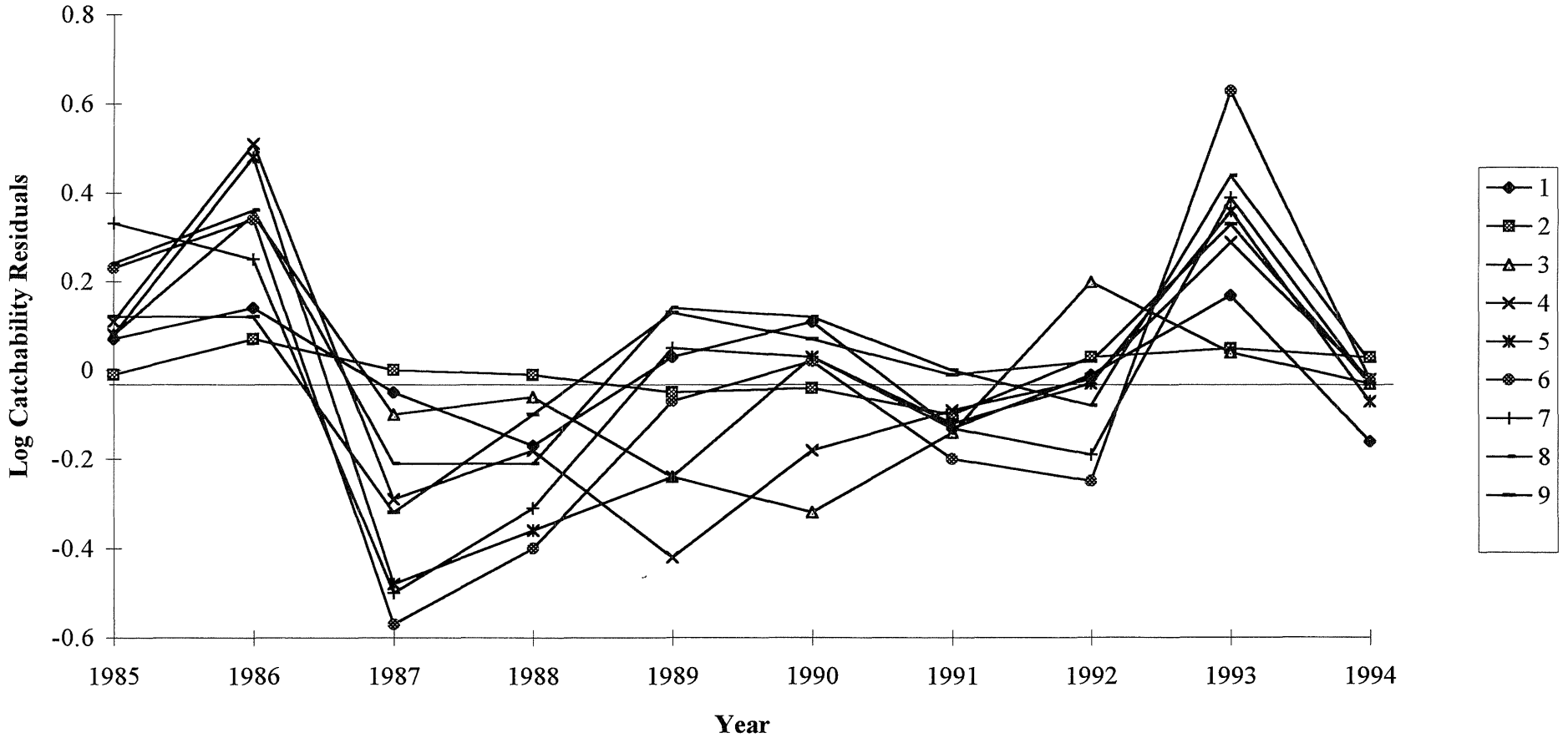
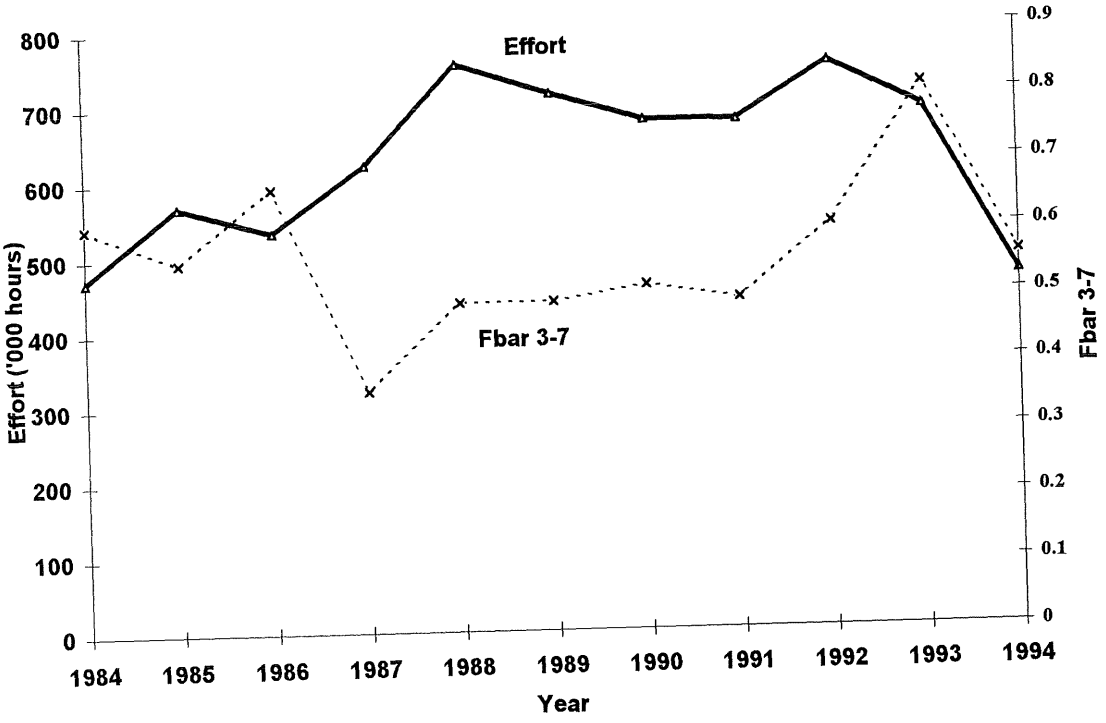


Figure 5.15.7 Bay of Biscay (FU's 23 and 24): Females - log catchability residuals from XSA



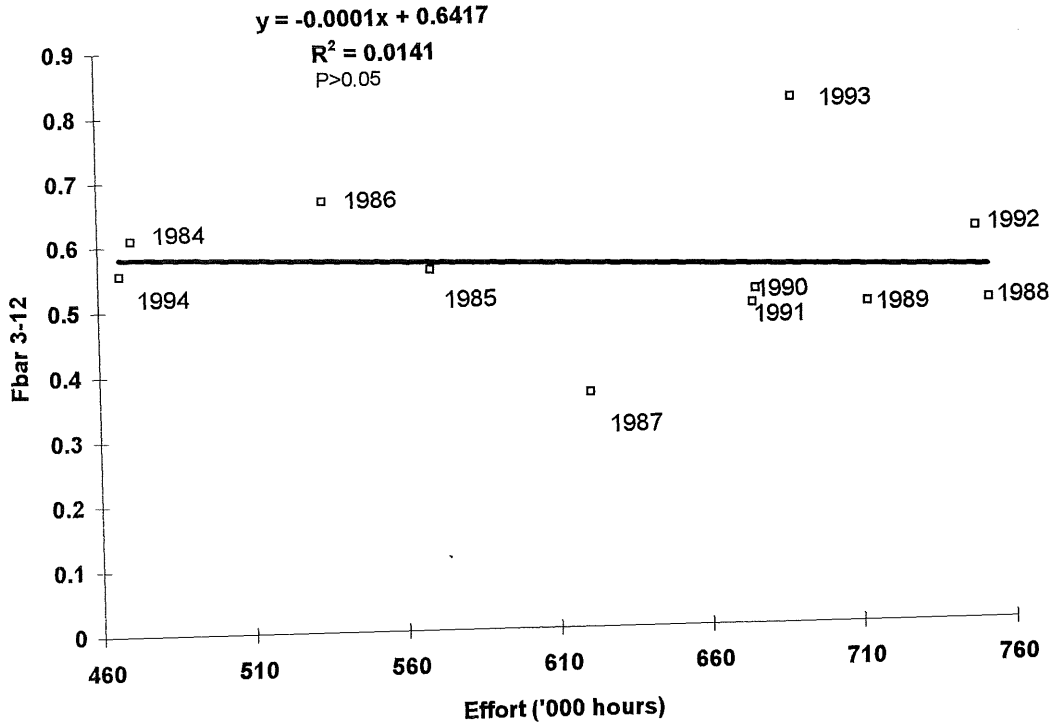
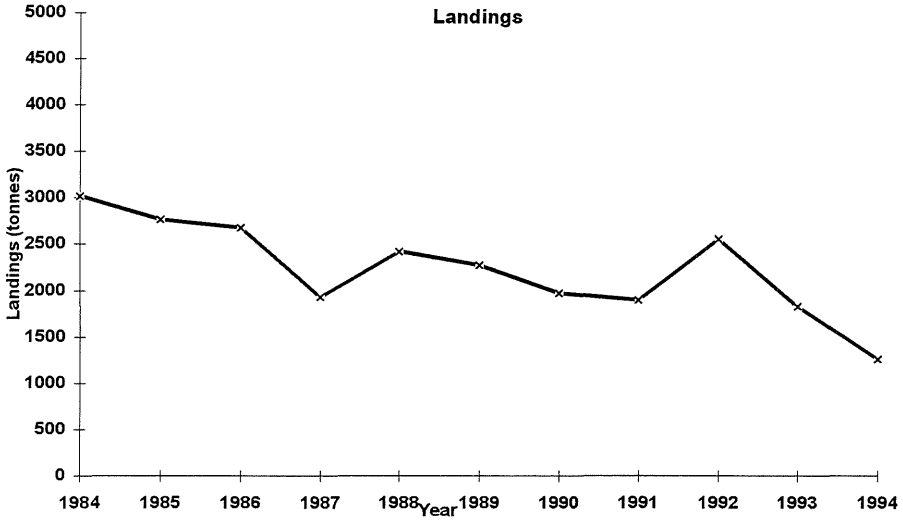


Figure 5.15.8 Bay of Biscay (FU's 23 and 24): Females - plot of effort and Fbar from XSA, together with their regression.



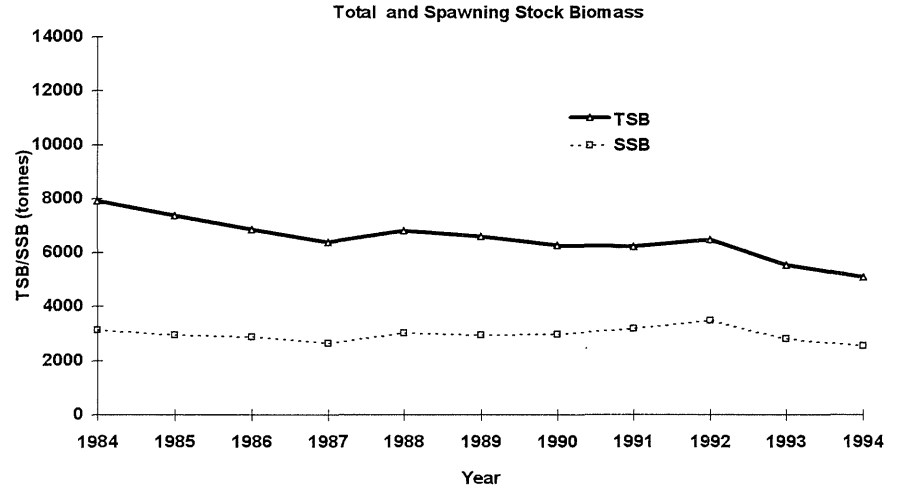


Figure 5.15.9 Bay of Biscay (FU's 23 and 24): Females - trends in landings, fishing mortality, total and spawning stock biomass, and Ln recruitment from XSA.

5.16. Division VIIIc (Management Area O)

Functional Units North Galicia (25)
Cantabrian Sea (31)

The statistical rectangles comprising this Management Area and its constituent Functional Units are shown in Figure 5.1.3.

5.16.1. North Galicia (Functional Unit 25)

Data and biological inputs

Landings, effort and length compositions were available for the period 1988-1994. The landings are sampled on a monthly basis in the port of La Coruña (Table 5.16.1). Input parameters to the assessments remained unchanged (Table 5.16.1).

Comments on general quality of inputs

The quality of landings and effort data collected in 1994 was believed to have been at the same level as in previous years. Effort data for trawlers fishing for both *Nephrops* and demersal fish and landing in La Coruña, were available for the whole period analysed. These cover about 80 % of the total effort in this FU.

Landings, effort and CPUE

Landings were reported by Spain only. After a fall from peak values in 1975-78 (Table 5.16.2, Figure 5.16.1), landings from the North Galicia *Nephrops* fishery have been fluctuating considerably over the period 1985-1994 with a slight downward trend. The figure for 1994 (245 t) was the lowest in the data series (Table 5.16.2).

Table 5.16.3 and Figure 5.16.1 give the fishing effort and the CPUEs for the fleet based in La Coruña. Fishing effort decreased from 1985 to 1987, a continuation of an earlier trend (Figure 5.16.1), and has since fluctuated without trend, despite a reduction in trawler activity since 1992. The CPUEs (discards are negligible in this fishery) fluctuated without trend (Table 5.16.3). The 1994 value is low, similar to that for 1993, and only slightly above the minimum recorded in 1990.

Figure 5.16.2 illustrates the seasonal patterns in landings, effort and CPUE by sex.

Mean size

Since 1985, the mean sizes of both males and females have fluctuated within a narrow range of values, with a peak for the males in 1989, and in 1990 for the females (Table 5.16.4, Figure 5.16.1). There are no clear trends, and both mean sizes seem to remain fairly stable.

Table 5.16.5 gives the abundance indices of *Nephrops* in North Galicia, derived from bottom trawl surveys carried out in autumn, mainly to estimate hake recruitment.

Assessments

Length-based assessment

A new length based assessment was made, using the data for the period 1988-1994, but the results did not differ from last year's LCA, using the 1984-1993 data (Tables 5.16.6 and 5.16.7).

Annualized mean Fs, calculated across the inter-quartile range, were 0.56 and 0.13 for males and females respectively. The Y/R curve for the males is flat-topped, with the current level of effort at 30 % above Fmax, but a reduction in effort from to Fmax would only result in small gains (<3 %) in long-term landings (Figure 5.16.3). The corresponding gains in biomass would be around 30 %. The Y/R curve for the females shows that a reduction in effort would produce proportional losses in the landings and gains in biomass (Figure 5.16.3).

Age-based assessment

A single fleet assessment was done, using the length compositions for 1984-1994. Though no changes in the input biological parameters were introduced, a new VPA was run in order to update the previous assessments. The method used was the NEPASS programme for a single fleet assessment. Input choices (Table 5.16.1) and tuning (Tables 5.16.8 and 5.16.10) for the VPA were the same as the ones used in last year's VPA (Anon., 1994b).

Males

Length compositions were split into 9 nominal age groups (with age class 10 being a plus group).

The catch-at-age matrix, the Fs-at-age, and the Ns-at-age are shown in Table 5.16.9. Annual mean F was calculated over the ages 2-8. The values are plotted against effort in Figure 5.16.4. The relationship between Fbar and effort was significant ($P < 0.05$). This is an improvement on last year's analysis, suggesting a better performance of the VPA.

Trends in the estimates of yields, mean F, TSB and recruitment are plotted in Figure 5.16.5. Yields and TSB show a decreasing trend during the period 1984-1994.

Females

The slicing procedure gave 9 nominal ages group (with age class 10 being a plus group). Table 5.16.11 gives the catch-at-age matrix, the Fs-at-age, and the Ns-at-age. Annual mean F was calculated over age groups 3-5. The relationship of Fbar against effort (Figure 5.16.6) suggests a negative trend, which is not realistic.

Trends in the estimates of yield, mean F, TSB and recruitment are plotted in Figure 5.16.7. As for the males, the yields, mean F and TSB show a decreasing trend, despite an apparently stable recruitment.

Management considerations

The results of the LCA indicate that the current level of effort is 30 % above Fmax for the males, and that a reduction in fishing effort from current F to Fmax would produce a small long-term gain, as opposed to long-term losses for the females.

The decreasing trends in yield and TSB for both males and females, as given by the VPA, suggest a continuous decline of the *Nephrops* stock in this area.

Particular attention should be drawn to the fact that the fishery in this FU is a mixed fishery, directed towards an assemblage of several demersal species. Most of the effort is targeted on blue whiting and hake, with *Nephrops* as a valuable by-catch species. Even though *Nephrops* ranks third in terms of revenue, it represents only 2 % of the total landings in weight. Decreases in the yields of the main target finfish species can be expected to be the main reason for a diversion of part of the effort directed at finfish, to a more *Nephrops* directed fishery.

The results of the LCA and VPA indicate that a reduction in fishing effort could be recommended for this FU. In view of the characteristics of this mixed fishery, and particularly the relatively minor role *Nephrops* plays as a target species, it can be expected that the TACs for the main target species will continue to define the levels of exploitation of *Nephrops*.

5.16.2. Cantabrian Sea (Functional Unit 31)

Data and biological inputs

Length composition data were obtained by monthly sampling of the landings in the ports of Avilés and Santander. Fishing effort and CPUE data for Avilés are not available for 1994. There is no new information on the biological parameters for this FU (Table 5.16.12).

Landings, effort and CPUE

Landings data are available for the years 1985-1994 (Table 5.16.13, Figure 5.16.8). Throughout this period, the total landings have been fluctuating between 91 and 172 tonnes. In 1994, the landings amounted to 148 t, an considerable increase compared to the most recent years. Since 1991, small landings by creels have been reported.

Effort data and CPUEs (discards are considered negligible) for the trawlers of Avilés are available for the period 1984-1993 (Table 5.16.14, Figure 5.16.8) but not for 1994. Total effort by this fleet has been decreasing since 1990. The CPUEs have been fluctuating between 2.4 and 6.9 kg/(BHP*day/100), with an increasing trend between 1985-1990.

Mean size

Data on the mean sizes of males and females are available for 1988-1994 (Table 5.16.15, Figure 5.16.8). Up to 1993, the mean sizes of females were stable around a mean of 38.0 mm CL. In 1994, they increased to 42.0 mm. The mean size of males has also been quite stable up to 1992 (around 41.4 mm CL), but in 1993 it increased to 46.6.mm CL.

Table 5.16.16 gives the abundance indices of *Nephrops* on the Cantabrian shelf, obtained from bottom trawl surveys carried out in autumn, mainly to estimate hake recruitment.

Assessments

Because there was no new information on input parameters, and pending the results of the ongoing revision of the length composition data, it was decided not to repeat the LCA carried out in 1991 (Anon., 1991).

Management considerations

There was no reason to change the advice given last year for *status quo* effort.

5.16.3. Summary of Division VIIIc (Management Area O)

Summaries of the recent landings from this Management Area are given by Functional Unit and country in Tables 5.16.17 and 5.16.18. For Management Area O it is suggested that fishing effort could be maintained at current levels but should not be allowed to increase.

Table 5.16.1 Data inputs and parameters: North Galicia

FU	25	MA	O (VIIIc)
FLEET	Spain	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch					
Landings	21	30	26	22	130
Discards					

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch										
Landings	99	73	73	73	70	52	37	23	35	14
Discards										

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	-	not applicable, few discards <1%
MALES		
Growth - K	0.16	adapted from other stocks
Growth - L(inf)	70	"
Nat. Mort. - M	0.2	"
Length/weight - a	0.00043	Farina, 1984
Length/weight - b	3.16	"
FEMALES		
Immature Growth		
K	0.16	as for males above
L(inf)	70	"
Nat.Mort. - M	0.2	"
Size at Maturity	24	
Mature Growth		
K	0.15	as for males
L(inf)	65	"
Nat.Mort. - M	0.2	"
Length/weight - a	0.00043	"
Length/weight - b	3.16	"

Table 5.16.2 North Galicia (Functional Unit 25): Landings (tonnes) by the Spanish fleet, 1985-94

Year	Spain	Total
1985	477	477
1986	364	364
1987	412	412
1988	445	445
1989	376	376
1990	285	285
1991	453	453
1992	428	428
1993	274	274
1994	245	245

Table 5.16.3 North Galicia (Functional Unit 25): Effort (days fishing) and CPUE (kg/day*BHP/100) of Spanish "bacas", home port La Coruña 1985-94

Year	Effort	CPUE
1985	6015	14.1
1986	5017	11.4
1987	4266	15.4
1988	5246	13.2
1989	5753	10.1
1990	5710	6.7
1991	5135	12.4
1992	5127	13.5
1993	5829	7.7
1994	5216	7.8

Table 5.16.4 North Galicia (Functional Unit 25): Mean sizes (CL mm) of male and female Nephrops in Spanish catches, 1985-94

Year	Males	Females
1985	35.8	33.1
1986	35.1	32.1
1987	37.2	35.6
1988	37.9	36.0
1989	40.9	38.7
1990	37.5	39.4
1991	34.8	33.3
1992	37.1	34.9
1993	37.4	36.0
1994	36.6	34.7

Table 5.16.5 Mean stratified catches and standard errors (SE) of Nephrops in bottom trawl surveys off North Galicia (Functional Unit 25)

	Kg / 30 minute haul		Nos. / 30 minute haul	
Year	Estimate	SE	Estimate	SE
1983	0.13	0.04	5.0	1.81
1984	0.51	0.19	18.5	5.17
1985	0.27	0.06	11.0	2.38
1986	0.33	0.12	12.6	5.49
1987				
1988	0.45	0.09	14.6	3.36
1989	0.08	0.02	2.20	0.77
1990	0.23	0.06	8.0	2.14
1991	1.31	0.47	51.5	16.23
1992	0.45	0.13	12.8	3.36
1993	0.25	0.06	7.60	2.23
1994	0.15	0.06	4.40	1.93

Table 5.16.6 North Galicia (FU25): Males - LCA output

COHORT ANALYSIS

L INFINITY = 70.0000 K = .1600

COHORT ANALYSIS BY EXACT CALCULATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
18.0	1.0	.2000	.2451	.0001	.0004	.2004	10030.8	2399.4	11335.4
20.0	12.0	.2000	.2551	.0013	.0051	.2051	9549.9	2373.9	15386.7
22.0	10.0	.2000	.2660	.0011	.0043	.2043	9063.1	2346.5	20274.0
24.0	28.0	.2000	.2778	.0034	.0121	.2121	8583.9	2315.9	26042.2
26.0	85.0	.2000	.2908	.0109	.0374	.2374	8092.7	2273.6	32605.3
28.0	293.0	.2000	.3049	.0408	.1338	.3338	7552.9	2189.8	39360.3
30.0	478.0	.2000	.3206	.0751	.2341	.4341	6822.0	2041.6	45305.6
32.0	674.0	.2000	.3379	.1248	.3694	.5694	5935.6	1824.6	49333.6
34.0	780.0	.2000	.3572	.1802	.5043	.7043	4896.7	1546.6	50361.2
36.0	793.0	.2000	.3789	.2433	.6420	.8420	3807.4	1235.1	47940.6
38.0	618.0	.2000	.4034	.2640	.6545	.8545	2767.4	944.2	43281.3
40.0	528.0	.2000	.4312	.3291	.7632	.9632	1960.5	691.8	37140.6
42.0	413.0	.2000	.4632	.4051	.8746	1.0746	1294.2	472.2	29468.4
44.0	262.0	.2000	.5003	.4288	.8572	1.0572	786.7	305.7	22021.9
46.0	149.0	.2000	.5438	.4124	.7583	.9583	463.6	196.5	16241.6
48.0	91.0	.2000	.5957	.4295	.7210	.9210	275.3	126.2	11901.9
50.0	40.0	.2000	.6585	.3113	.4727	.6727	159.1	84.6	9054.1
52.0	33.0	.2000	.7361	.4242	.5762	.7762	102.1	57.3	6920.1
54.0	14.0	.2000	.8346	.3044	.3648	.5648	57.7	38.4	5213.6
56.0	18.0	.2000			.2000	.4000	36.0	38.4	5213.6
				TOTAL BIOMASS INCLUDES LENGTHS ABOVE +GP			23502.3		524402.0

Table 5.16.7 North Galicia (FU25): Females - LCA output

COHORT ANALYSIS

LOWER CURVE LINF= 70.0000 K= .1600

UPPER CURVE LINF= 60.0000 K= .0800

TRANSITION LENGTH= 24.0000

COHORT ANALYSIS BY EXACT CALCULATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
20.0	1.0	.2000	.2551	.0001	.0003	.2003	13185.5	3279.6	21256.9
22.0	2.0	.2000	.2660	.0002	.0006	.2006	12528.5	3245.2	28039.5
24.0	27.0	.2000	.2778	.0023	.0084	.2084	11877.5	3206.1	36052.9
26.0	97.0	.2000	.7578	.0094	.0124	.2124	11209.3	7846.2	112521.4
28.0	287.0	.2000	.8067	.0331	.0410	.2410	9542.9	6996.4	125753.3
30.0	442.0	.2000	.8624	.0631	.0732	.2732	7856.7	6036.6	133955.8
32.0	590.0	.2000	.9264	.1098	.1185	.3185	6207.3	4979.6	134636.6
34.0	610.0	.2000	1.0005	.1570	.1569	.3569	4621.4	3888.5	126619.6
36.0	515.0	.2000	1.0876	.1943	.1786	.3786	3233.7	2882.9	111896.2
38.0	396.0	.2000	1.1914	.2317	.1945	.3945	2142.2	2036.3	93340.8
40.0	235.0	.2000	1.3170	.2215	.1682	.3682	1338.9	1397.3	75015.9
42.0	190.0	.2000	1.4723	.3066	.2083	.4083	824.4	912.3	56934.5
44.0	99.0	.2000	1.6691	.2951	.1768	.3768	452.0	560.0	40345.0
46.0	61.0	.2000	1.9269	.3589	.1863	.3863	241.0	327.5	27069.5
48.0	29.0	.2000	2.2790	.3726	.1635	.3635	114.5	177.4	16727.5
50.0	25.0	.2000			.2000	.4000	50.0	177.4	16727.5
				TOTAL BIOMASS INCLUDES LENGTHS ABOVE +GP			47949.1		1156893.0

Table 5.16.8 North Galicia (FU25): Males - VPA tuning information

Age 2

Fleet	F	var(F)	wt	slope	int	N
AL AL	.1189	.7221E+00	.4714	.0000E+00	-.1069E+02	10
Hist F	.1217	.6440E+00	.5286	.0000E+00	-.2106E+01	10

Tuned F= .1203

Age 3

Fleet	F	var(F)	wt	slope	int	N
AL AL	.5263	.1267E+00	.4620	.0000E+00	-.9201E+01	10
Hist F	.5387	.1088E+00	.5380	.0000E+00	-.6185E+00	10

Tuned F= .5329

Age 4

Fleet	F	var(F)	wt	slope	int	N
AL AL	.7320	.9844E-01	.5053	.0000E+00	-.8871E+01	10
Hist F	.7493	.1005E+00	.4947	.0000E+00	-.2886E+00	10

Tuned F= .7405

Age 5

Fleet	F	var(F)	wt	slope	int	N
AL AL	.8627	.1119E+00	.5246	.0000E+00	-.8707E+01	10
Hist F	.8831	.1235E+00	.4754	.0000E+00	-.1243E+00	10

Tuned F= .8724

Age 6

Fleet	F	var(F)	wt	slope	int	N
AL AL	.8141	.1417E+00	.5320	.0000E+00	-.8765E+01	10
Hist F	.8334	.1611E+00	.4680	.0000E+00	-.1823E+00	10

Tuned F= .8231

Age 7

Fleet	F	var(F)	wt	slope	int	N
AL AL	.5545	.2994E+00	.4983	.0000E+00	-.9149E+01	10
Hist F	.5676	.2974E+00	.5017	.0000E+00	-.5663E+00	10

Tuned F= .5610

Table 5.16.9 North Galicia (FU25): Males - VPA output

N-at-age

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	13087.	12001.	10829.	7705.	7993.	10805.	12040.	7651.	6334.	10166.	352.
2	11648.	10622.	9675.	8733.	6249.	6531.	8846.	9853.	6222.	5168.	8137.
3	8857.	6591.	6704.	6659.	6234.	4333.	5211.	2531.	2930.	2921.	1988.
4	2925.	2995.	2887.	3271.	3711.	2359.	1932.	6801.	5647.	4124.	3817.
5	1322.	986.	1162.	1103.	1688.	1136.	797.	1361.	1154.	848.	670.
6	559.	387.	270.	498.	411.	508.	247.	361.	663.	303.	199.
7	195.	109.	90.	108.	148.	175.	71.	95.	153.	338.	83.
8	71.	40.	25.	35.	49.	80.	40.	24.	50.	71.	223.
9	53.	16.	1.	16.	20.	29.	12.	11.	13.	10.	30.
10	10.	15.	33.	30.	85.	40.	25.	16.	9.	3.	21.

F-at-age

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.0087	.0154	.0150	.0094	.0021	.0000	.0004	.0068	.0034	.0226	.1000
2	.3693	.2602	.1736	.1372	.1662	.0256	.0630	.3566	.2112	.1032	.1203
3	.8844	.6255	.5174	.3846	.7717	.3375	.3758	.6449	.8442	.5584	.5329
4	.8871	.7469	.7620	.4617	.9840	.8846	.4202	.7316	1.0374	.8878	.7405
5	1.0296	1.0947	.6468	.7864	1.0001	1.3249	.5912	.5195	1.1365	1.2505	.8724
6	1.4343	1.2627	.7209	1.0109	.6520	1.7732	.7556	.6566	.4729	1.0990	.8231
7	1.3770	1.2864	.7364	.5903	.4229	1.2759	.8975	.4490	.5675	.2149	.5610
8	1.3052	4.1883	.2635	.3523	.3299	1.6890	1.1332	.3937	1.3674	.6738	.1000
9	1.3722	2.2458	.5736	.6512	.4683	1.5794	.9288	.4997	.8026	.6626	.4947
10	1.3722	2.2458	.5736	.6512	.4683	1.5794	.9288	.4997	.8026	.6626	.4947

Catch-at age data

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	103.	166.	146.	65.	15.	0.	5.	47.	19.	206.	30.
2	3280.	2216.	1401.	1017.	870.	150.	490.	2695.	1078.	460.	838.
3	4782.	2807.	2476.	1939.	3077.	1131.	1489.	2961.	2959.	1614.	1442.
4	1582.	1446.	1413.	1105.	2141.	1274.	793.	1395.	1739.	1076.	927.
5	783.	606.	507.	551.	983.	772.	326.	504.	724.	559.	358.
6	395.	256.	127.	292.	181.	393.	120.	159.	228.	187.	102.
7	135.	73.	43.	44.	47.	117.	39.	31.	61.	60.	33.
8	48.	38.	5.	10.	13.	60.	25.	7.	34.	32.	19.
9	37.	13.	0.	7.	7.	21.	7.	4.	7.	5.	11.
10	7.	12.	13.	13.	29.	30.	14.	6.	5.	1.	8.

Year	Yield	Fbar2 -8	TSB	SSB	Log R
1984	415.6	1.0410	987.4	987.4	9.48
1985	293.0	1.3521	824.7	824.7	9.39
1986	232.8	.5458	777.1	777.1	9.29
1987	214.5	.5319	784.9	784.9	8.95
1988	326.7	.6181	816.0	816.0	8.99
1989	224.6	1.0444	576.7	576.7	9.29
1990	143.4	.6052	701.1	701.1	9.40
1991	273.1	.5360	780.1	780.1	8.94
1992	289.4	.8053	696.0	696.0	8.75
1993	184.6	.6839	564.3	564.3	9.23
1994	154.0	.5358	500.2	500.2	5.86

Table 5.16.10 North Galicia (FU25): Females - VPA tuning information

```
Age  3

Fleet    F       var(F)      wt      slope          int       N

 AL AL   .0835   .6671E+00 1.0000   .0000E+00 -.1104E+02   10
Hist F Not used

Tuned F= .0835

Age  4

Fleet    F       var(F)      wt      slope          int       N

 AL AL   .1559   .1345E+00 1.0000   .0000E+00 -.1042E+02   10
Hist F Not used

Tuned F= .1559

Age  5

Fleet    F       var(F)      wt      slope          int       N

 AL AL   .2155   .5218E-01 1.0000   .0000E+00 -.1009E+02   10
Hist F Not used

Tuned F= .2155
```

Table 5.16.11 North Galicia (FU25): Females - VPA output

N-at-age

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	11762.	10650.	9397.	10771.	11027.	11559.	9575.	8198.	7953.	2282.	1673.
2	13149.	9156.	7837.	7249.	8293.	9013.	9464.	7762.	6441.	6467.	1794.
3	9648.	9939.	6206.	5853.	5426.	6587.	7364.	7535.	5470.	5068.	5173.
4	6056.	6774.	6666.	4507.	4164.	3953.	5276.	2899.	3793.	3677.	3335.
5	3569.	3921.	4635.	4733.	3002.	2830.	2801.	5666.	5036.	3815.	3983.
6	2501.	2355.	2632.	3235.	3037.	2067.	1791.	1965.	2413.	2262.	2248.
7	1311.	1802.	1589.	1738.	2014.	2155.	1222.	1084.	1191.	1428.	1426.
8	1430.	952.	1182.	1112.	1073.	1404.	1262.	727.	621.	681.	870.
9	2657.	2215.	2159.	3495.	3866.	3431.	3443.	2091.	1294.	1112.	1263.

F-at-age

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	.0504	.1066	.0596	.0614	.0016	.0000	.0099	.0412	.0067	.0401	.1000
2	.0799	.1888	.0919	.0896	.0303	.0021	.0279	.1500	.0397	.0233	.2000
3	.1538	.1995	.1200	.1405	.1167	.0218	.0621	.2030	.1603	.0407	.0835
4	.2348	.1795	.1424	.2062	.1862	.1103	.1299	.2323	.2120	.1088	.1559
5	.2156	.1987	.1595	.2436	.1732	.2574	.1888	.2525	.2860	.1947	.2155
6	.1275	.1936	.2150	.2739	.1430	.3257	.3026	.3008	.3246	.2615	.2000
7	.1197	.2215	.1570	.2818	.1609	.3355	.3197	.3565	.3589	.2952	.2000
8	.1542	.2045	.1771	.2664	.1590	.3062	.2704	.3033	.3232	.2505	.2052
9	.1542	.2045	.1771	.2664	.1590	.3062	.2704	.3033	.3232	.2505	.2052

Catch-at age data

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	525.	978.	493.	582.	16.	0.	85.	300.	48.	81.	145.
2	916.	1432.	625.	564.	225.	17.	236.	983.	227.	135.	296.
3	1250.	1635.	637.	697.	543.	129.	402.	1259.	736.	183.	376.
4	1153.	1012.	804.	764.	643.	375.	584.	1069.	875.	357.	522.
5	629.	643.	621.	931.	434.	585.	453.	771.	833.	537.	494.
6	272.	377.	463.	706.	368.	524.	426.	465.	609.	474.	371.
7	134.	326.	210.	389.	272.	560.	305.	296.	327.	332.	235.
8	186.	160.	175.	237.	143.	337.	272.	173.	156.	137.	147.
9	345.	373.	319.	744.	517.	824.	743.	498.	326.	224.	213.

Year	Yield	Fbar 3-5	TSB	SSB	Log R
1984	153.9	.2014	1297.3	1144.4	9.37
1985	188.5	.1926	1222.2	1083.8	9.27
1986	134.1	.1406	1122.2	1009.4	9.15
1987	199.6	.1968	1209.8	1069.8	9.28
1988	121.1	.1587	1193.2	1038.9	9.31
1989	156.2	.1298	1020.9	1020.9	9.36
1990	144.1	.1269	1147.9	1023.4	9.17
1991	182.1	.2293	1021.0	906.3	9.01
1992	142.2	.2195	882.0	770.7	8.98
1993	91.8	.1147	744.4	717.0	7.73
1994	93.4	.1516	657.0	635.3	7.42

Table 5.16.12 Data and input parameters: Cantabrian Sea

FU 31	MA O (IIIc)
FLEET Spain	GEAR Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch					
Landings	6	10	9	5	111
Discards					

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch										
Landings	30	29	29	24	35	38	17			
Discards										

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival		Not applicable, few discards
MALES		
Growth - K	0.15	based on other stocks, (Anon.,1991)
Growth - L(inf)	90	Maximum size observed in samples
Nat. Mort. - M	0.2	assumed the same as FU25
Length/weight - a	0.00043	" (based on Farina,1984)
Length/weight - b	3.16	"
FEMALES		
Immature Growth		Not applicable, few below CL50 mat.
K		
L(inf)		
Nat.Mort. - M		
Size at Maturity		
Mature Growth		
K	0.1	as for males
L(inf)	70	"
Nat.Mort. - M	0.2	"
Length/weight - a	0.00043	"
Length/weight - b	3.16	"

Table 5.16.13 Cantabrian Sea (Functional Unit 31): Landings (tonnes) by the Spanish fleet, 1985-94

Year	Spain (trap)	Spain (trawl)	Total
1985		128	128
1986		127	127
1987		118	118
1988		151	151
1989		139	139
1990		172	172
1991	4	105	109
1992	2	92	94
1993	6	85	91
1994	2	146	148

Table 5.16.14 Cantabrian Sea (Functional Unit 31): Effort (no. of trips) and CPUE (kg/(BHP*days)/100) of Spanish trawlers, home port Avilés, 1985-94

Year	Effort	CPUE
1985	2207	2.4
1986	2407	3.1
1987	1869	4.5
1988	2077	5.9
1989	1611	5.3
1990	2013	6.9
1991	1798	3.6
1992	1118	3.2
1993	1074	3.0
1994	NA	NA

Table 5.16.15 Cantabrian Sea (Functional Unit 31): Mean sizes (Cl mm) of male and female Nephrops in Spanish catches, 1985-94

Year	Males	Females
1988	40.3	36.9
1989	42.3	39.2
1990	42.0	37.4
1991	40.9	37.1
1992	41.6	39.3
1993	45.2	39.6
1994	46.6	42.0

Table 5.16.16 Mean stratified catches and standard errors (SE) of Nephrops in bottom trawl surveys in the Cantabrian Sea (Functional Unit 31)

	Kg / 30 minute haul		Nos. / 30 minute haul	
Year	Estimate	SE	Estimate	SE
1983	0.04	0.01	0.6	0.14
1984	0.09	0.04	2.7	1.27
1985	0.16	0.07	2.5	0.93
1986	0.26	0.11	3.4	1.20
1987				
1988	0.22	0.09	6.1	2.80
1989	0.05	0.02	1.4	0.76
1990	0.12	0.04	3.1	1.29
1991	0.10	0.05	2.5	1.22
1992	0.15	0.06	2.2	0.82
1993	0.13	0.04	2.9	1.03
1994	0.13	0.06	2.6	1.08

Table 5.16.17 Nephrops landings (tonnes) by Functional Unit plus other rectangles in Management Area O (VIIIc)

Year	FU 25	FU 31	Other	Total
1985	477	128		605
1986	364	127		491
1987	412	118		530
1988	445	151		596
1989	376	139		515
1990	285	172		457
1991	453	109		562
1992	428	94		522
1993	274	91		365
1994	245	148		393

Table 5.16.18 Nephrops Landings (tonnes) by country in Management Area O (VIIIc)

Year	Spain	Total
1985	605	605
1986	491	491
1987	530	530
1988	596	596
1989	515	515
1990	457	457
1991	562	562
1992	522	522
1993	365	365
1994	393	393

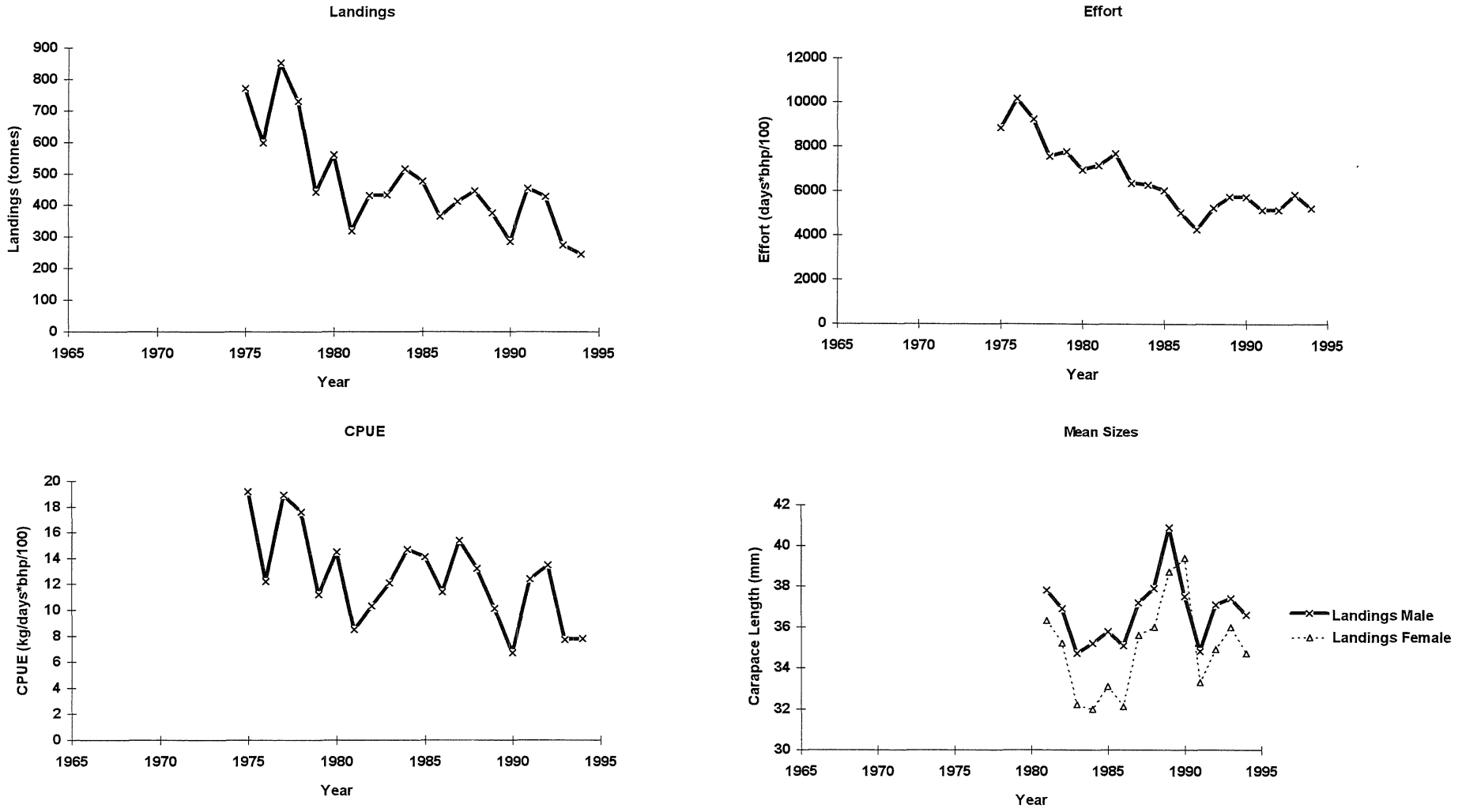


Figure 5.16.1 North Galicia (FU25): Long term trends in Spanish landings (tonnes), effort (days*bhp/100), CPUE (kg/days*bhp/100) and mean sizes (mm CL) in landings

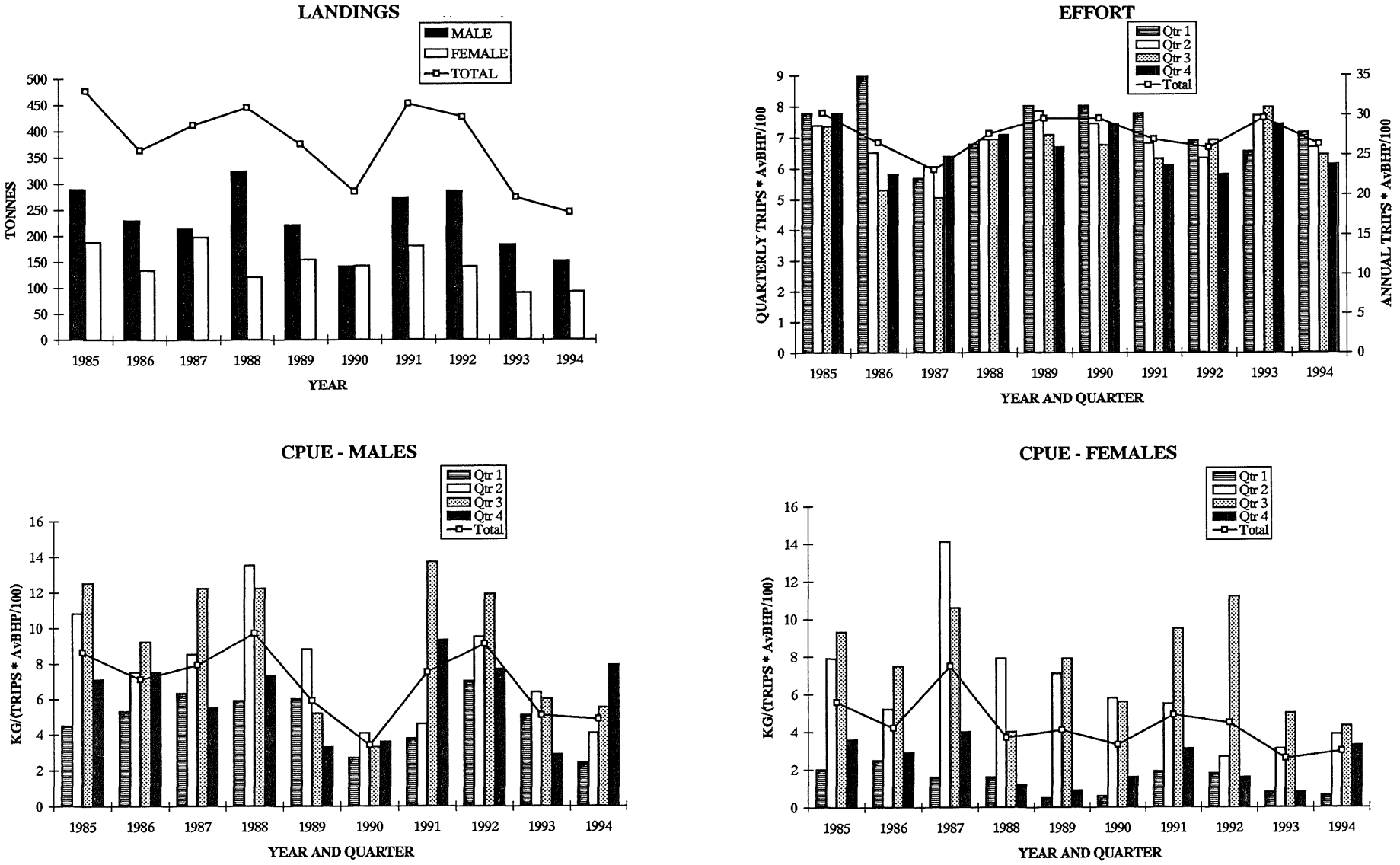


Figure 5.16.2. North Galicia (functional unit 25) : trends in landings,effort and CPUE by quarter and sex from Spanish Nephrops trawlers.

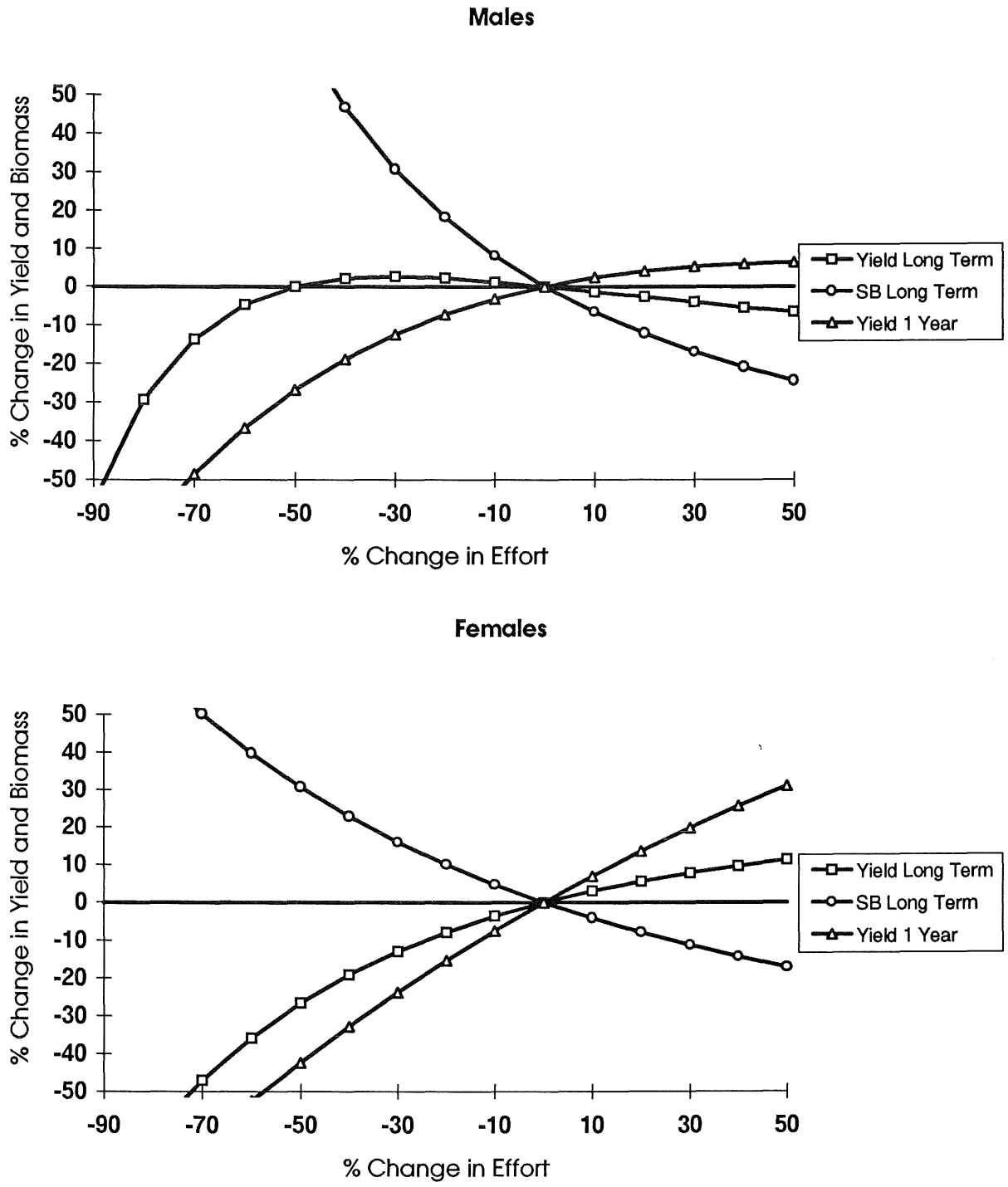
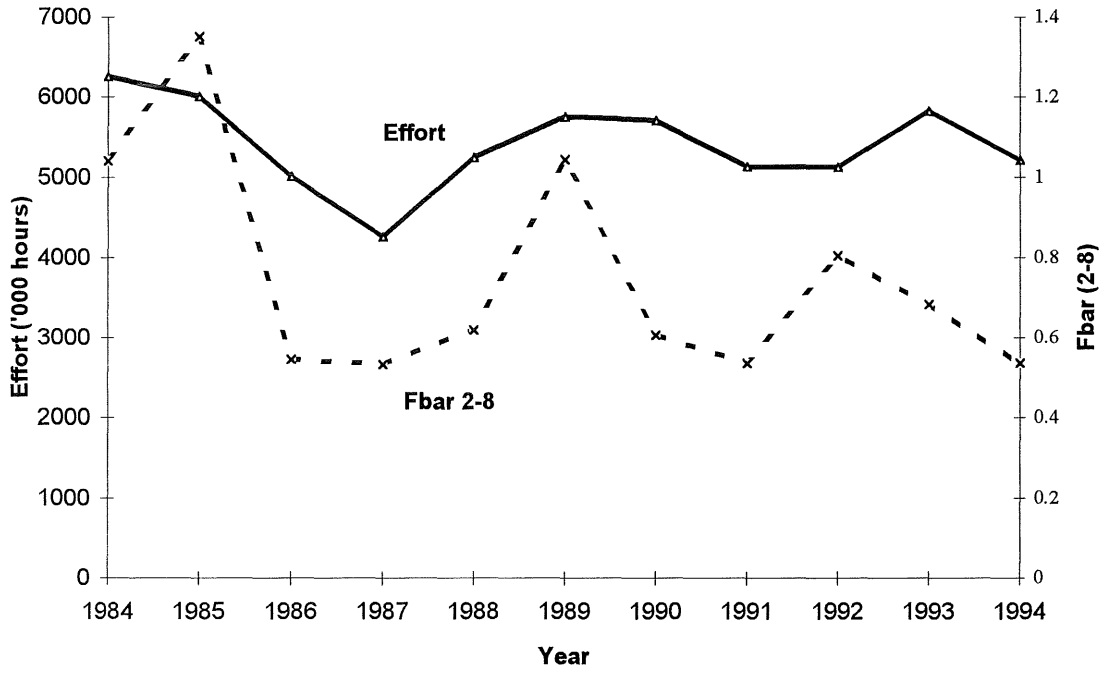


Figure 5.16.3 North Galicia (FU25): Percentage changes in long term landings and stock biomass, and short term landings following various changes in fishing effort. Males and females shown separately



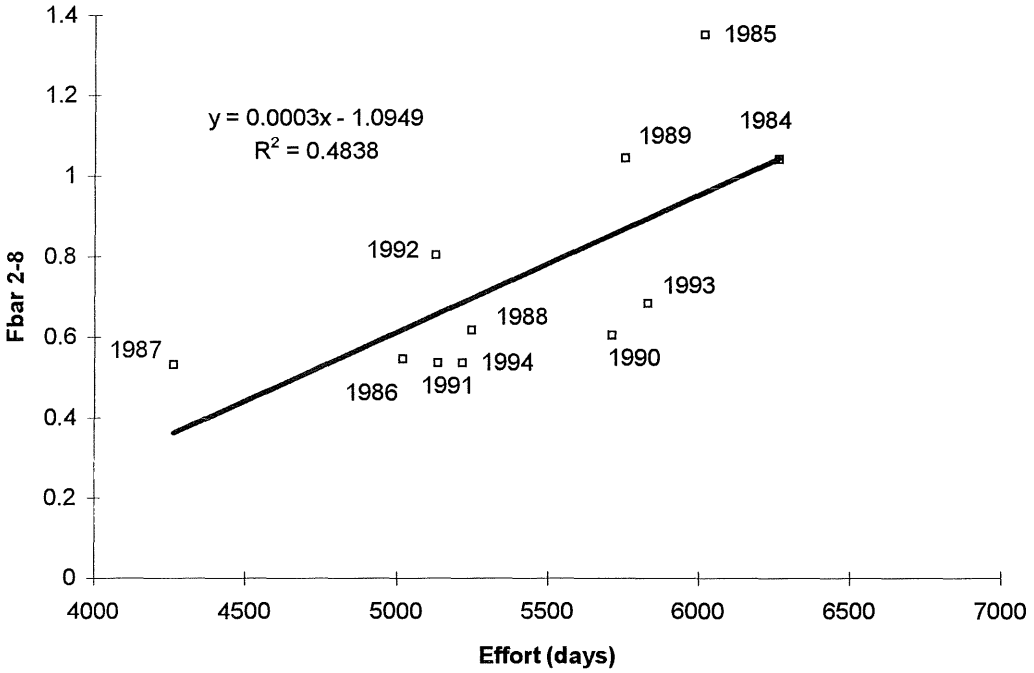


Figure 5.16.4 North Galicia (FU25): Males - plot of effort and Fbar from XSA, together with their regression.

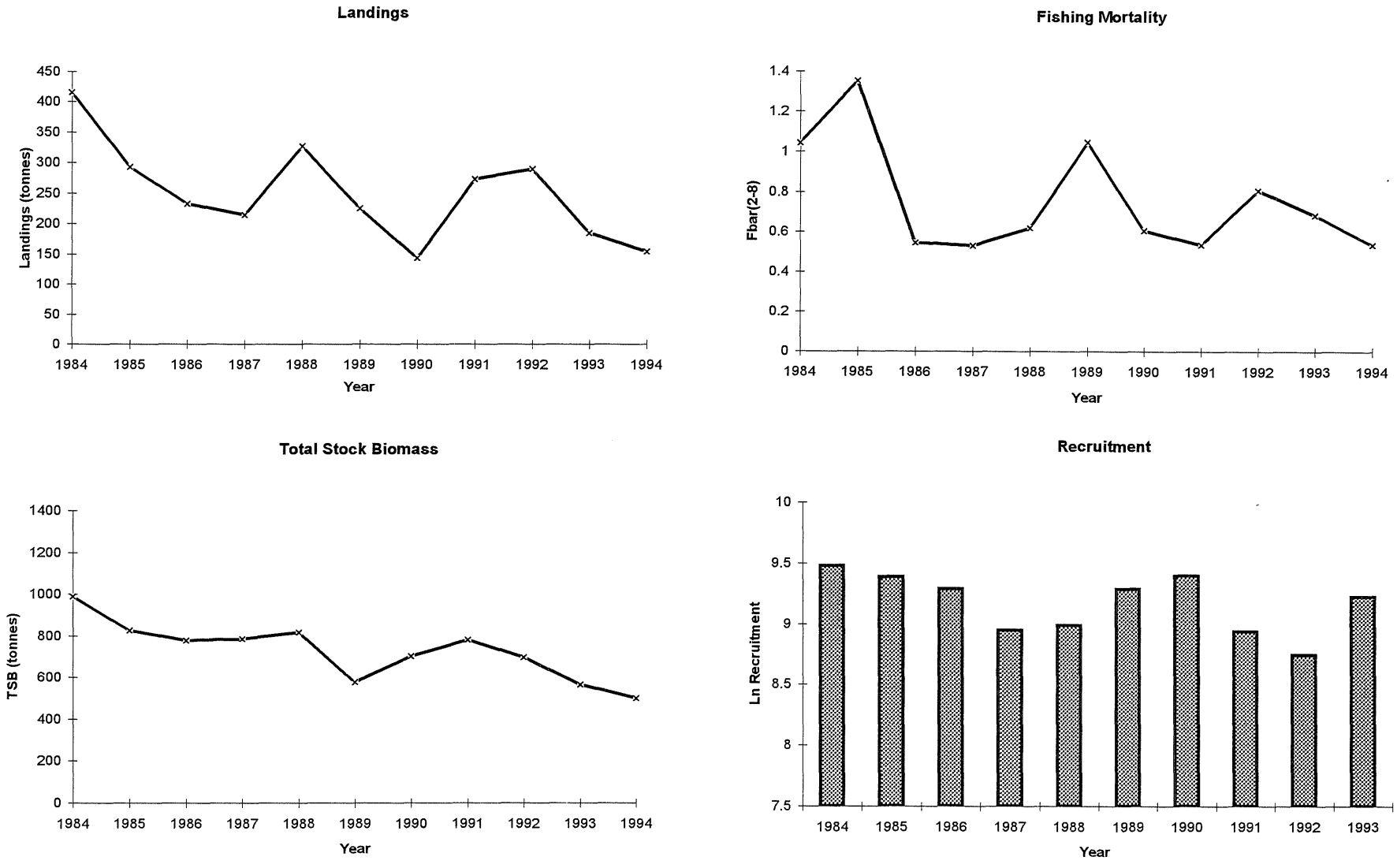
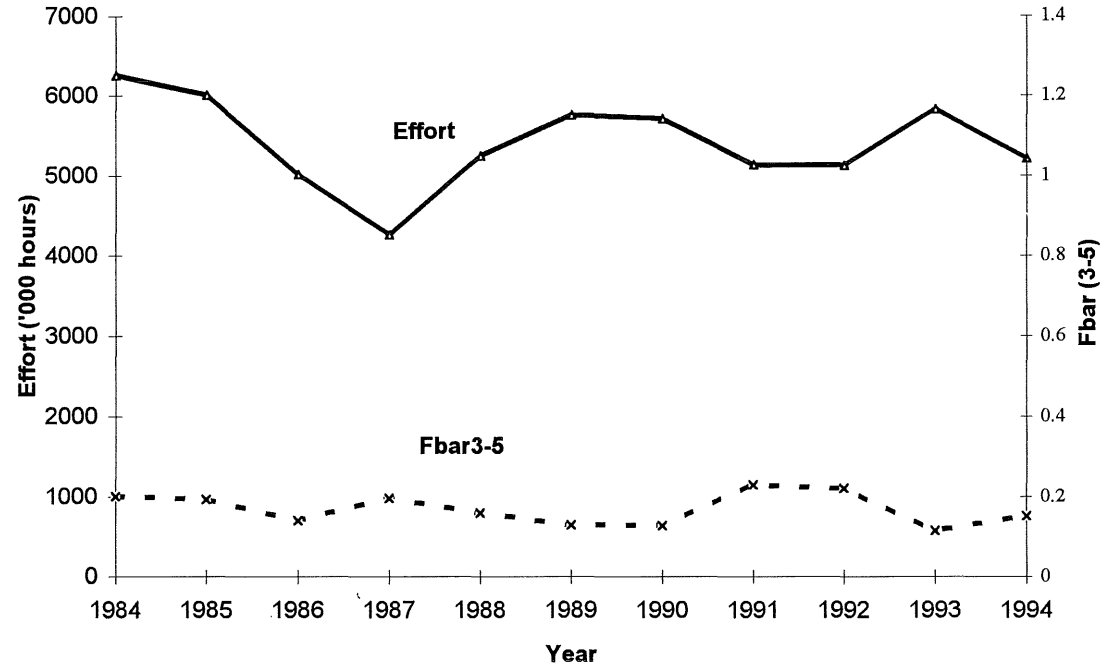
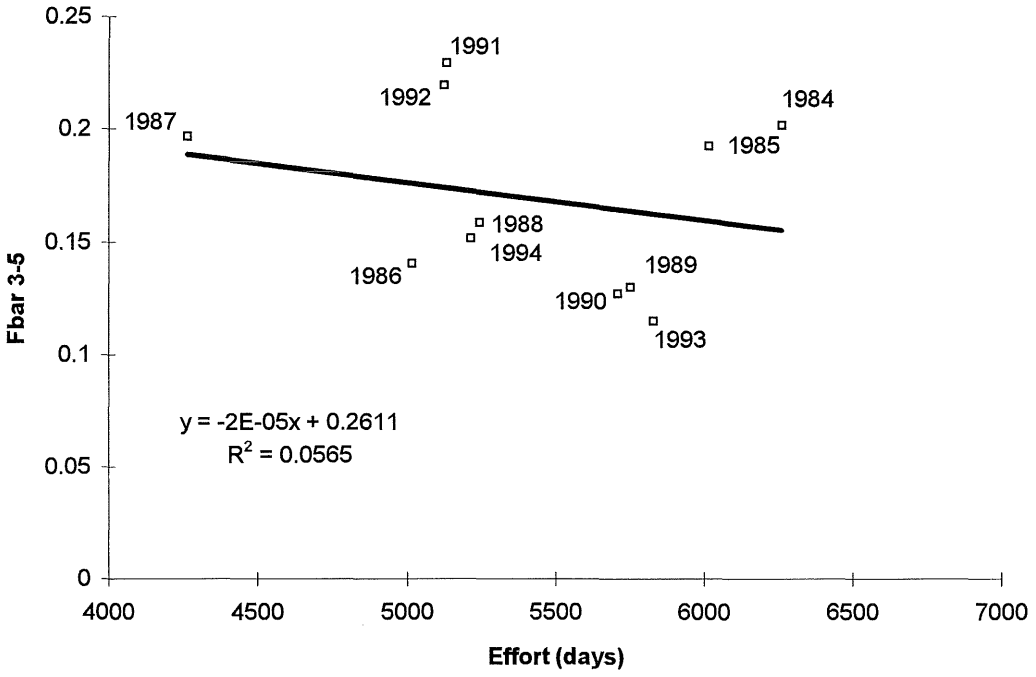


Figure 5.16.5 North Galicia (FU25): Males - trends in landings, fishing mortality, total stock biomass, and Ln recruitment from XSA.





igure 5.16.6 North Galicia (FU25): Females - plot of effort and Fbar from XSA, together with their egression.

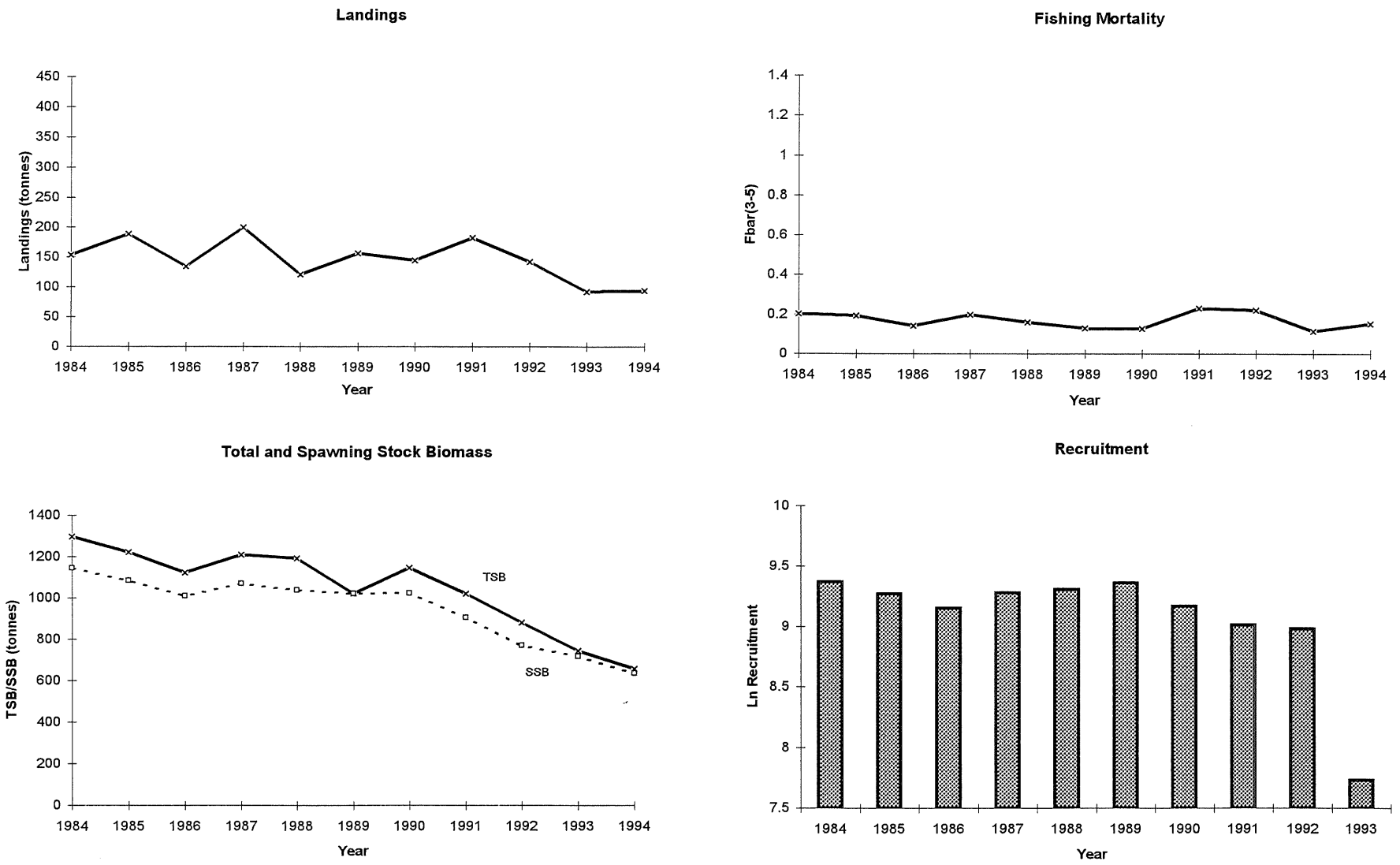
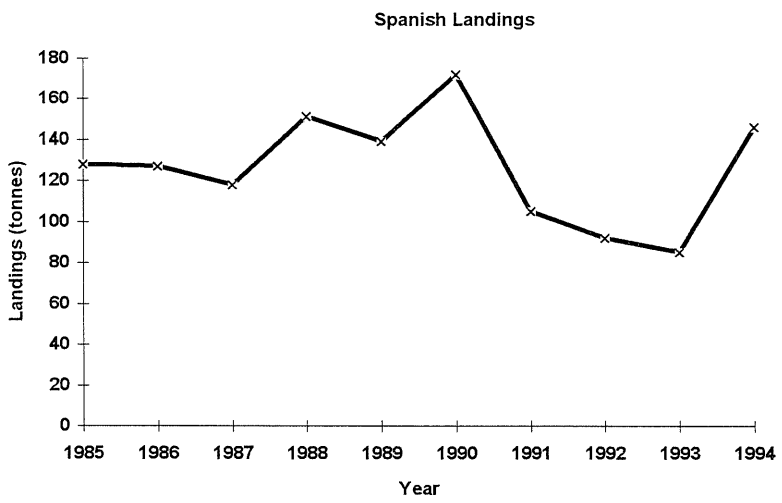
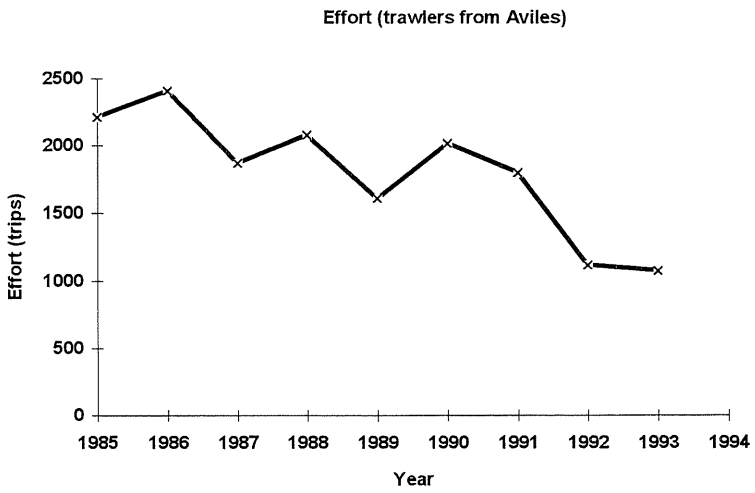
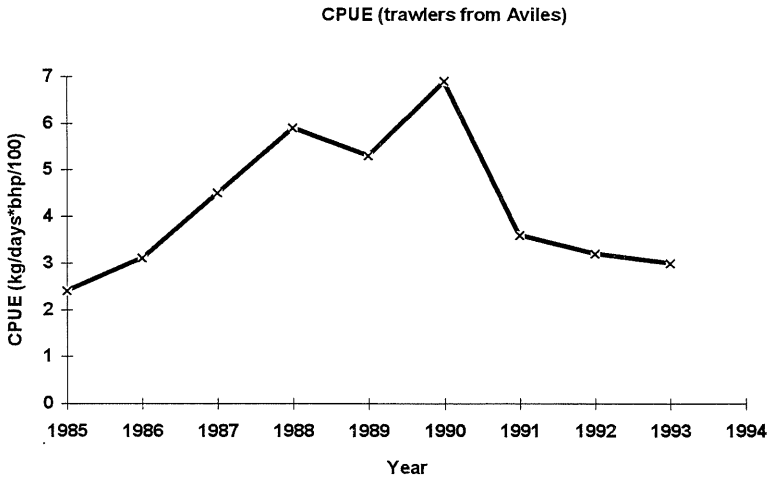


Figure 5.16.7 North Galicia (FU25): Females - trends in landings, fishing mortality, total and spawning stock biomass, and Ln recruitment from XSA.







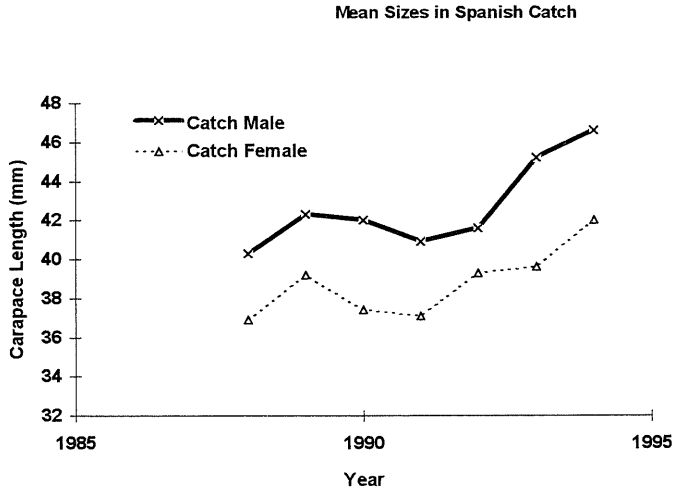


Figure 5.16.8 Cantabrian Sea (FU31): Longterm trends in Spanish landings (tonnes), effort (trips), CPUE (kg/days*bhp/100) and mean size (mm CL) in catch.

5.17. Divisions VIIId,e (Management Area P)

Functional Units - None

5.17.1. Summary of Divisions VIIId,e (Management Area P)

Zero TAC to prevent misreporting

5.18. Division IXa (Management Area Q)

Functional Units
- West Galicia (26)
- North Portugal (27)
- SW and S Portugal (28 and 29)
- Gulf of Cadiz (30)

The statistical rectangles comprising this Management Area and its constituent Functional Units are shown in Figure 5.1.3.

5.18.1. Introduction

Recent information has shown that the landings from FUs 26 and 27 are mixed, with Spanish boats, which fish in both FUs, landing into Spain, and Portuguese boats fishing in FU 27 landing into both Spanish and Portuguese harbours. Since the recording of landings by "foreign" vessels is rather poor, there are no reliable estimates of the quantities landed or the fishing effort involved in these fisheries. The Working Group acknowledges that, under these circumstances, there is an urgent need to establish a co-operative statistics collection and sampling programme to split the landings by FU, and to estimate the length compositions of the catches coming from each FU. Provided such a collection and sampling program can be set up, it might be possible to perform future assessments on a FU basis. If not, the assessments may have to be done for both FUs combined (as is already the case for e.g. FUs 28 and 29), but the differences in exploitation pattern and size composition indicate that separate assessments would be preferable.

5.18.2. West Galicia (Functional Unit 26)

Data and biological inputs

Landings and length compositions data, additional to the existing time series, are available for 1994. There was no new information on biological parameters (Table 5.18.1).

Comments on general quality of inputs

Landings were sampled on a monthly basis at the port of Marín. In 1993, 2-3 samples were taken each month (Table 5.18.1). Part of the fleet based in Marín fishes on grounds located off North Portugal, i.e. outside FU 26. Their catches are being landed in Spain, but landings and effort data are not reported by area.

The length compositions include mixed samples from both areas, and before a new assessment can be made a thorough revision of the data and/or the boundaries of these two FUs is required.

Pending these revisions, the landings, effort and CPUE data are presented following the historical series.

Landings, effort and CPUE

Landings data were reported for Spanish vessels only. The landings in 1994 of 426 t were the second lowest of the last 10 years (Table 5.18.2), and there has been an overall decline in landings since 1981 (Figure 5.18.1).

CPUE data (discards are considered negligible) are available for the fleets of Muros and Riveira since 1984, and for the fleet of Marín since 1990 (Table 5.18.3, Figure 5.18.1). These data show considerable fluctuations, with the lowest values being recorded in 1990, corresponding with the lowest values of the landings. The figures for Marín are much higher than those for the other ports, due to the fact that the Marín vessels, which fish on the more offshore grounds, usually stay out for three days per trip, as opposed to only one day per trip for the vessels of Muros and Riveira, which fish exclusively on the grounds close to the West Galician coast.

Mean size

The mean size of males and females in the landings are given in Table 5.18.4 and Figure 5.18.1 for the period 1985-1994 (there are no data for 1987). Mean sizes of males and females fluctuated without obvious trend until 1988, when a drop in mean size of both sexes occurred in 1989 and 1990. Subsequently, the mean sizes increased again, and since 1991 they have remained reasonably stable.

Table 5.18.5 gives the abundance indices of *Nephrops* in West Galicia, derived from data collected during bottom trawl surveys carried out in autumn, mainly to estimate hake recruitment.

Assessments

In view of the problems summarized in the Introduction to this MA, and in the absence of any new biological input parameters, there was no reason to repeat the assessments done in 1993 (Anon., 1993).

Management considerations

Taking into account the results of the last LCA (Anon., 1993) it was considered that effort should be at least stabilised because the Y/R curves indicated that a reduction in fishing effort to Fmax would produce modest long-term gains. The management option suggested previously, i.e. to maintain *status quo* conditions, is considered appropriate.

5.18.3. North Portugal (North of Lisbon) (Functional Unit 27)

Data and biological inputs

No biological parameters are available for this FU. The length compositions of the catches for the period 1985-1992 were estimated from a few samples collected from one Portuguese harbor, Matosinhos (Table 5.18.6). For 1996, a new sampling programme will be established in connection with the Spanish fisheries laboratory in La Coruña.

Comments on general quality of inputs

The length compositions of trawl catches are based on a small number of samples which did not cover all months and all years. No samples were collected in 1994. Some of the boats (both Portuguese and Spanish) fishing in this FU land their catches in the Spanish harbours of Vigo and Marin, and there is no information on the landings composition of these vessels.

Landings

Table 5.18.7 and Figure 5.18.2 show the estimated total landings for the years 1983-1991, the official landing figures for 1992-1994, and a break-down of the landings by gear type (trawl and creel) since 1984. Total landings from this FU have fluctuated between 11 and 66 t, without any obvious long-term trend.

Effort

Fishing effort and CPUE for the trawl fishery were estimated in 1992 for the period 1985-1991 (Table 5.18.8 and Figure 5.18.2), based on data obtained from log-books and shipowner associations. There are no effort or CPUE data available for 1993-1994. Over the period 1985-1991 the CPUE has been fluctuating, without any obvious trend.

Mean size

Mean size data for males and females, derived from port samples and from demersal research surveys, are available for 1985-1993 (Table 5.18.9, Figure 5.18.2). The mean sizes in the landings are higher in this FU than in the southern part of Portugal. Bearing in mind, however, that the mean sizes for this FU are based on very small numbers of measurements, and that the research surveys were carried out with different codend mesh sizes, it is impossible to draw any definite conclusions from these data.

Assessments and Management Considerations

In view of the problems described in the Introduction to this MA, and in the absence of new information on the biological parameters, there seemed to be no reason to repeat the LCA performed at the 1991 Working Group meeting (Anon, 1991).

Due to a lack of information no advice is offered for this FU.

5.18.4. South West and South Portugal (Functional Units 28 and 29)

Data and biological inputs

Length distributions of the Portuguese trawl landings were obtained once or twice a month in the home ports of the fleets, viz. Vila Real de Santo Antonio, Portimão and Olhão in Portugal, and Ayamonte in Spain. The 1994 quarterly sampling levels are summarized in Table 5.18.10. Sampling effort was concentrated in the 1st and 2nd quarter, which constitute the main season for this *Nephrops* fishery. The sampling data were raised to the total landings by market category, vessel and month. It was assumed that there were no discards.

Input parameters (Table 5.18.10) are the same as those used in last year's report (Anon., 1994b). Since the last LCA (Anon., 1993) values for natural mortality have been adjusted upwards (male M = 0.3 (previously 0.2), female M = 0.3/0.2 (0.2/0.1)), the female size at maturity increased from 26 mm CL to 30 mm CL, and the K value for females set at 0.065 (previously 0.068) (Tables 5.18.10 and 3.4.1).

Comments on general quality of inputs

In 1993 and 1994 the length compositions of the landings were sampled much more frequently than in previous years, particularly during the first half of the year, which is the peak season for the *Nephrops* fishery. The effort data were estimated from log-books. An EU-funded quality assessment of the data contained in the log-books is currently in progress, and the results of this study will be available for next year's meeting of the Working Group .

Landings

Table 5.18.11 and Figure 5.18.3 show the annual landings by gear (trawl and creel). Since 1985, the estimated catches have fluctuated around an average of 454 t per year. In 1994, the landings decreased to 318 t, 30 % below the 10 year average.

In 1980, the international landings from these FUs reached a peak value of 1 607 t, when the Spanish fleet was fishing in Portuguese waters under a bilateral agreement, but these activities stopped in 1983. Since 1991, however, the Spanish trawlers have resumed fishing for *Nephrops* off South Portugal, but there are no landings data for this fleet.

The landings predominantly consist of males, with overall shares ranging between 60 % to 70 %, (Figure 5.18.4).

Effort

Fishing effort (estimated in fishing days), peaked in 1985 at 10505 days, and then decreased to a low of 3945 days in 1989, where it has more or less stabilised (Table 5.18.12 and Figure 5.18.3). The amount of effort targeting *Nephrops* is difficult to evaluate since it is a mixed fishery for both shrimps and *Nephrops*. A study is currently in progress to apportion the effort on the three main Crustacean species (*Parapenaeus, Aristeus* and *Nephrops*) in this fishery.

CPUE

The catch per fishing day increased from 1985 to 1989, then gradually decreased again (Table 5.18.12, Figure 5.18.3). This trend is observed in the CPUEs of both the males and the females, with peaks in 1989 and 1988 respectively (Figure 5.18.4). The highest CPUEs occur during the first half of the year.

Mean size

Mean length data for males and females in the landings and from research survey catches are available for 1983-1994 (Table 5.18.13, Figure 5.18.3). The mean sizes of both male and female *Nephrops* in the landings have remained fairly stable. Fluctuations in the mean sizes for both sexes in the survey samples may be due to differences in the codend mesh sizes used.

Assessments

Length-based assessments

An LCA was carried out for males and females separately, with data for the reference period 1992-1994. Outputs are given in Tables 5.18.14 and 5.18.15 for males and female respectively.

The long-term Y/R curve for males (Figure 5.18.5) suggests that current F is 20 % above Fmax, but the curve is very flat-topped. Previous LCAs (Anon., 1991, 1993) gave more dome-shaped male Y/R curves with the current F>20% above Fmax. The main reason for this change is the higher value of natural mortality used this time. The Y/R relationship for the females, however, has a curvilinear shape with an Fmax far beyond the range of effort increases investigated (Figure 5.18.5), and was also completely different to the curves obtained in 1991 and 1993(Anon., 1991, 1993). This difference may also be explained by changes made in the input parameters, particularly natural mortality which was increased to 0.3/0.2, and length at 50 % maturity which was set at 30 mm CL.

Age-based assessments

A VPA was carried out on both males and females using Portuguese data for 1984-1994.

Males

The slicing procedure (L2AGE) generated 9 nominal age groups, the last one being a plus-group. Table 5.18.16 shows the numbers-at-age in the catches, the mean weights-at-age in catch and stock, together with the natural mortalities-at-age used as an input to the Lowestoft VPA.

A Laurec-Shepherd tuning was carried out to check the stability of catchability with respect to time using both the crustacean directed effort data for 1984-1994, and the *Nephrops* survey data for 1990-1994 (Table 5.18.17 and Figure 5.18.6). For the crustacean fleet, the diagnostics gave quite low residuals with a year effect in 1985 and 1986. The survey data show higher variances in log-catchabilities.

An XSA tuning (Table 5.18.18, residuals Figure 5.18.7) was performed with the default options, assuming that catchability is dependent on stock size for all ages < 4, and with a prior weighing of 1 for the crustacean fleet and 0.1 for the surveys. Table 5.18.19 and Figure 5.18.9 show the trends in landings, fishing mortality, TSB and recruitment. Fbar(1-6), which averaged 0.56, has increased since 1988, with a peak in 1992. Conversely, stock biomass and recruitment have decreased slightly since 1990, except for the year 1992.

Last year's VPA (using the NEPASS program with a Laurec/Shepherd tuning) gave different values for Fbar, with a mean of 0.45. The plot (Anon., 1994b) of Fbar versus fishing effort revealed a statistically significant relationship ($p < 0.05$), as opposed to the one this year from the XSA tuning, which is not significant (Figure 5.18.8).

Females

The slicing procedure (L2AGE) generated 11 nominal age groups (the last one being a plus-group). Table 5.18.20 shows the numbers-at-age in the catches, the mean weights-at-age in catch, and the natural mortality rates-at-age used in the VPA.

A Laurec-Shepherd tuning was carried out along the same lines as explained for the males (Table 5.18.21 and Figure 5.18.10). For the crustacean fleet, the diagnostics gave residuals higher than for the males, with year effects in 1985 and 1986. The surveys had an insufficient number of data points to perform this type of analysis.

An XSA tuning (Table 5.18.22, residuals Figure 5.18.11) was performed with the default options, and assuming that catchability is independent from stock size for all ages, a SE of 0.3 on the mean to which the estimates are shrunk, and a prior weighing of 0.5 for the crustacean fleet data and 0.1 for the survey data. Tables 5.18.23 and Figure 5.18.13 show the trends in landings, fishing mortality, TSB and recruitment. Fbar (average 0.27) has tended to increase since 1991, while stock biomass has decreased slightly since 1991, and recruitment since 1992.

Last year's VPA (Anon., 1994b), gave different values for Fbar, and, as for the males, the plot of Fbar versus fishing effort was much better than the one produced this year (Figure 5.18.12).

Comments on quality of the assessments

The growth parameters and the value of M are the main sources of uncertainty in the assessment, but ongoing research is expected to yield better estimates in the near future. Other sources of uncertainty are related to the estimation of fishing effort and the problems with unreported landings.

Management Considerations

The conclusion from the long-term assessments is that fishing mortality should be reduced. Stock biomass and recruitment of both males and females show a decreasing trend, but until there is an improvement in the data and performance of the VPA it is recommended that there should be no increase in fishing effort.

5.18.5. Gulf of Cádiz (Functional Unit 30)

Data and biological inputs

Biological data or length compositions are not available for this FU.

Landings and effort

Landings are available for the period 1985-1994. Since 1992, the landings have decreased from 243 to 107 t in 1994, after having fluctuated between 139 and 302 tonnes in the previous years (1985-1991) (Table 5.18.2). Fishing effort data are not available.

Mean size and abundance indices

The information on mean sizes of males and females, and on the abundance indices derived from research surveys carried out in March and October 1993 were given in last year's report (Anon., 1994b).

Assessments and Management Consideration

Length compositions of the landings are not available for this FU, and no assessments were carried out.

Due to a lack of information no advice is offered for this FU.

5.18.6. Summary of Division IXa (Management Area Q)

Summaries of the landings from this Management Area are given by Functional Unit in Table 5.18.24 and by country in Table 5.18.25.

The agreed TAC of 2500 t for this MA is more than twice the landings (5 year average of 1156 t), and nearly double the ACFM recommended TAC of 1300 t. The agreed TAC is not compatible with the recommendation for FU 28 and 29 that fishing effort should not be allowed to increase. There appears to be no reason for changing the advice given last year for this Management Area.

Table 5.18.1 Data inputs and parameters: West Galicia

FU 26	MA Q
FLEET Spain	GEAR Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch					
Landings	8	9	9	7	245
Discards					

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch										
Landings	33	29	26	35	38	29	18		40	
Discards										

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival		Not applicable, few discards
MALES		
Growth - K	0.15	based on Fernandez et al. 1986
Growth - L(inf)	85	Fernandez et al,1986
Nat. Mort. - M	0.2	"
Length/weight - a	0.00043	Farina, 1984
Length/weight - b	3.16	"
FEMALES		
Immature Growth		
K	0.15	as for males
L(inf)	85	"
Nat.Mort. - M	0.2	"
Size at Maturity	24	
Mature Growth		
K	0.1	based on other FU's
L(inf)	70	Fernandez et al.,1986
Nat.Mort. - M	0.2	"
Length/weight - a	0.00043	as for males
Length/weight - b	3.16	"

Table 5.18.2 West Galicia (Functional Unit 26) and Gulf of Cadiz (Functional Unit 30): Landings (tonnes) by the Spanish fleet, 1985-94

Year	West Galicia	Gulf of Cadiz
1985	731	257
1986	655	221
1987	671	302
1988	631	139
1989	620	174
1990	401	220
1991	549	226
1992	584	243
1993	472	160
1994*	426	107

* provisional

Table 5.18.3 West Galicia (Functional Unit 26): CPUE data (kg/trip) for Spanish trawlers, from home ports of Muros and Riveira 1985-94, and Marin 1990-94

Year	Muros	Riveira	Marin
1985	33.5	30.7	?
1986	23.9	28.0	?
1987	20.3	25.3	?
1988	15.4	22.0	?
1989	16.4	27.4	?
1990	14.5	20.6	103.3
1991	26.4	29.6	117.5
1992	28.9	26.5	113.0
1993	17.3	22.4	105.4
1994	17.8	21.5	113.9

* provisional

Table 5.18.4 West Galicia (Functional Unit 26) : Mean sizes (CL mm) of male and female Nephrops in Spanish catches, 1985-94

Year	Males	Females
1985	34.3	31.3
1986	36.6	31.9
1987	?	?
1988	35.0	32.9
1989	29.9	28.5
1990	26.0	24.8
1991	31.7	30.4
1992	36.4	33.3
1993	32.4	33.3
1994	36.0	34.4

Table 5.18.5 Means of stratified catches in bottom trawl surveys - West Galicia (Functional Unit 26)

	Kg / 30 minute haul		Nos. / 30 minute haul	
Year	Estimate	SE	Estimate	SE
1983	0.40	0.16	15.1	6.44
1984	0.24	0.09	9.90	3.72
1985	0.14	0.06	9.10	4.67
1986	0.49	0.19	21.9	8.60
1987				
1988	0.60	0.27	25.0	10.34
1989	0.43	0.12	20.0	5.18
1990	0.55	0.21	20.8	7.41
1991	0.67	0.33	25.4	12.33
1992	0.38	0.16	15.2	5.85
1993	0.12	0.10	4.80	3.89
1994	0.06	0.02	1.50	0.61

Table 5.18.6 Data input and parameters: North Portugal

FU	27	MA	Q
FLEET	Portugal	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch	0	0	0	0	0
Landings					
Discards					

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch	0	12	5	3	7	18	48		3	30
Landings										
Discards										

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival		Not applicable, few discards
MALES		
Growth - K	0.2	Inputs 'borrowed' from FU 28,29
Growth - L(inf)	70	"
Nat. Mort. - M	0.2	"
Length/weight - a	0.00028	"
Length/weight - b	3.22	"
FEMALES		
Immature Growth		
K	0.2	"
L(inf)	70	"
Nat.Mort. - M	0.2	"
Size at Maturity	26	"
Mature Growth		
K	0.068	"
L(inf)	65	"
Nat.Mort. - M	0.2	"
Length/weight - a	0.00056	"
Length/weight - b	3.03	"

Table 5.18.7 North Portugal (Functional Unit 27) : Landings (tonnes) by gear, all Portugal 1985-94

Year	Trawl	Creel	Spain Trawl	Total
1985	11	4		15
1986	28	9		37
1987	52	19		71
1988	55	41		96
1989	66	22		88
1990	31	17		48
1991	40	14		54
1992	37	15		52
1993	36	14		50
1994*	14	8	NA	22

* provisional

Table 5.18.8 North Portugal (Functional Unit 27): Effort and CPUE for Portuguese trawl fishery, 1985-94

Year	No. trawlers	Tonnes/ boat	Est. hours	CPUE kg/hr
1985	2	5.3	5362	2.0
1986	3	9.5	6538	4.3
1987	7	7.5	14208	3.7
1988	10	5.5	12251	4.5
1989	7	9.4	9400	7.0
1990	9	3.5	8970	3.5
1991	8	5.0	7499	5.3
1992	8	4.6	NA	NA
1993	5	7.2	NA	NA
1994*	3	4.7	NA	NA

* provisional

Table 5.18.9 North Portugal (Functional Unit 27) : Mean sizes (CL mm) of male and female Nephrops in Portuguese trawl landings and research trawl surveys, 1985-94

	Landings		Research Surveys	
Year	Males	Females	Males	Females
1985	40.3	36.6	42.6	39.9
1986	40.3	40.9	47.0	39.4
1987	No sampling		41.7	41.2
1988	41.3	41.0	39.5	33.0
1989	40.8	40.7	No surveys	
1990	39.6	39.1	42.2	40.0
1991	34.4	34.2	38.7	33.2
1992	35.0	35.4	40.9	35.6
1993	37.9	38.0	39.0	37.8
1994	NA	NA	NA	NA

Table 5.18.10 Data and input parameters: SW and S Portugal

FU	28&29	MA	Q (XIa)
FLEET	Portugal	GEAR	Trawl

1994	NUMBER OF SAMPLES				Mean
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	No./sample
Catch					
Landings	20	42	34	12	70
Discards					

	NUMBER OF SAMPLES									
YEAR	94	93	92	91	90	89	88	87	86	85
Catch										
Landings	108	60	38	23	31	38	81	68	113	179
Discards										

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival		Not applicable, few discards
MALES		
Growth - K	0.2	Portuguese data, Bhattacharya method
Growth - L(inf)	70	and tagging release. Anon., 1990
Nat. Mort. - M	0.3	Figueiredo, M.J. ICES, Doc. C.M.1989/K:25(1989)
Length/weight - a	0.00028	Figueiredo, M.J. pers comm (1986)
Length/weight - b	3.22	"
FEMALES		
Immature Growth		
K	0.2	as for males
L(inf)	70	"
Nat.Mort. - M	0.3	"
Size at Maturity	30	Anon 1994 in prep
Mature Growth		
K	0.065	as for males
L(inf)	65	"
Nat.Mort. - M	0.2	"
Length/weight - a	0.00056	"
Length/weight - b	3.03	"

Table 5.18.11 South-west Portugal (Functional Unit 28) and South Portugal (Functional Unit 29): Landings (tonnes) by country and gear, 1985-94

Year	Portugal			Spain trawl	Total
	Trawl	Creel	Total		
1985	509	0	509	0	509
1986	465	0	465	0	465
1987	498	11	509	0	509
1988	405	15	420	0	420
1989	463	6	469	0	469
1990	520	4	524	0	524
1991	473	5	478	0	478
1992	469	1	470	NA	470
1993	375	1	376	NA	376
1994*	318	0	318	NA	318

* provisional

Table 5.18.12 South west Portugal (Functional Unit 28) and South Portugal (Functional Unit 29): Effort and CPUE in the Portuguese trawl fishery, 1985-94

Year	No.trawlers	Tonnes/boat	Est. days	kg/days
1985	39	13.0	10505	54.0
1986	41	11.3	7295	64.0
1987	41	12.1	6794	75.0
1988	38	10.7	4398	96.0
1989	34	13.6	3945	119.0
1990	37	9.8	5783	90.0
1991	39	12.1	4975	96.0
1992	39	12.1	5654	83.0
1993	33	11.4	5029	75.0
1994*	31	10.3	5827	54.0

Table 5.18.13 South west Portugal (Functional Unit 28) and South Portugal (Functional Unit 29): Mean sizes (CL mm) of male and female Nephrops in Portuguese trawl landings and research trawl surveys, 1985-94

Year	Landings		Research Surveys	
	Males	Females	Males	Females
1985	37.3	34.2	36.0	30.0
1986	36.6	32.7	36.0	32.0
1987	34.0	31.9	34.0	31.0
1988	35.1	32.5	37.3	34.4
1989	37.4	33.5	33.6	29.9
1990	37.5	33.6	34.1	39.4
1991	36.6	31.9	37.5	31.7
1992	36.6	33.0	37.8	33.6
1993	36.7	33.9	39.5	34.1
1994	37.2	33.5	42.5	35.7

Table 5.18.14 SW and S Portugal (FU's 28 & 29): Male - LCA output

COHORT ANALYSIS

L INFINITY = 70.0000 K = .2000

COHORT ANALYSIS BY EXACT CALCULATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
22.0	95.0	.3000	.2128	.0071	.0332	.3332	13924.9	2860.6	19603.1
24.0	219.0	.3000	.2223	.0176	.0792	.3792	12971.7	2764.9	24789.1
26.0	277.0	.3000	.2326	.0244	.1047	.4047	11923.2	2646.8	30410.4
28.0	665.0	.3000	.2440	.0656	.2690	.5690	10852.0	2471.8	35755.2
30.0	1058.0	.3000	.2565	.1236	.4820	.7820	9445.5	2195.0	39364.0
32.0	918.0	.3000	.2703	.1319	.4878	.7878	7729.0	1881.9	41283.7
34.0	847.0	.3000	.2858	.1524	.5332	.8332	6246.4	1588.5	42124.5
36.0	742.0	.3000	.3031	.1714	.5653	.8653	4922.9	1312.6	41633.1
38.0	583.0	.3000	.3227	.1759	.5451	.8451	3787.1	1069.6	40199.8
40.0	377.0	.3000	.3450	.1479	.4287	.7287	2883.2	879.4	38833.5
42.0	384.0	.3000	.3705	.1992	.5376	.8376	2242.4	714.3	36775.1
44.0	414.0	.3000	.4002	.3098	.7741	1.0741	1644.1	534.8	31878.9
46.0	234.0	.3000	.4351	.2649	.6088	.9088	1069.6	384.4	26357.8
48.0	200.0	.3000	.4766	.3520	.7387	1.0387	720.3	270.8	21235.4
50.0	96.0	.3000	.5268	.2686	.5098	.8098	439.1	188.3	16800.9
52.0	62.0	.3000	.5889	.2680	.4550	.7550	286.6	136.3	13761.5
54.0	53.0	.3000	.6677	.3803	.5696	.8696	183.7	93.1	10590.0
56.0	17.0	.3000	.7708	.2039	.2646	.5646	102.8	64.2	8204.0
58.0	16.0	.3000	.9116	.3187	.3496	.6496	66.5	45.8	6531.4
60.0	23.0	.3000			.5000	.8000	36.8	.0	.0
				TOTAL BIOMASS INCLUDES LENGTHS ABOVE +GP				22103.1	526131.3

Table 5.18.15 SW and S Portugal (FU's 28 & 29): Females - LCA output

COHORT ANALYSIS

LOWER CURVE LINF= 70.0000 K= .2000

UPPER CURVE LINF= 65.0000 K= .0650

TRANSITION LENGTH= 30.0000

COHORT ANALYSIS BY EXACT CALCULATION

SIZE MM	REMOVALS	M	DT	FDT	F	Z	NO. ATTAINING	AVE. NO. IN SEA	BIOMASS kg
18.0	.1	.3000	.1961	.0000	.0000	.3000	16618.9	3165.0	13232.8
20.0	25.5	.3000	.2041	.0017	.0082	.3082	15669.3	3099.7	17548.9
22.0	75.5	.3000	.2128	.0053	.0250	.3250	14713.8	3025.3	22560.7
24.0	246.5	.3000	.2223	.0187	.0843	.3843	13730.7	2925.1	28080.5
26.0	502.6	.3000	.2326	.0421	.1812	.4812	12606.6	2774.2	33622.8
28.0	890.1	.3000	.2440	.0854	.3501	.6501	11271.7	2542.8	38265.8
30.0	1297.7	.2000	.2565	.1489	.5805	.7805	9618.8	2235.7	41175.0
32.0	1143.6	.2000	.9619	.1734	.1803	.3803	7873.9	6342.9	141172.4
34.0	669.8	.2000	1.0260	.1454	.1417	.3417	5461.7	4726.9	125729.7
36.0	492.0	.2000	1.0994	.1532	.1394	.3394	3846.5	3529.4	111086.2
38.0	315.0	.2000	1.1840	.1429	.1207	.3207	2648.6	2609.3	96323.4
40.0	228.0	.2000	1.2828	.1534	.1196	.3196	1811.8	1906.7	81896.3
42.0	119.3	.2000	1.3996	.1204	.0860	.2860	1202.4	1386.8	68812.4
44.0	82.4	.2000	1.5397	.1260	.0818	.2818	805.8	1006.6	57317.0
46.0	43.6	.2000	1.7112	.1036	.0605	.2605	522.1	720.8	46825.4
48.0	28.4	.2000	1.9256	.1077	.0559	.2559	334.3	508.3	37458.1
50.0	23.5	.2000	2.2016	.1526	.0693	.2693	204.2	339.2	28218.0
52.0	9.4	.2000	2.5701	.1123	.0437	.2437	112.9	215.6	20151.8
54.0	3.4	.2000	3.0872	.0793	.0257	.2257	60.3	134.2	14029.6
56.0	8.1	.2000	3.8664	.4682	.1211	.3211	30.1	66.6	7756.6
58.0	2.0	.2000	5.1765	.4379	.0846	.2846	8.7	23.5	3043.1
60.0	.7	.2000			.1000	.3000	2.0	.0	.0
				TOTAL BIOMASS INCLUDES LENGTHS ABOVE +GP				43284.5	1034306.0

Table 5.18.16 SW and S Portugal (FU'S 28 & 29): Males - VPA input

Catch numbers at age Numbers*10**-3

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	2054	2795	1732	4058	2026	2318	1908	2520	3116	1924	1115
2	2863	3796	3419	3289	3691	2162	3767	2985	3072	3633	2084
3	1909	1520	2099	1281	1490	1937	2880	2261	1600	1126	987
4	751	855	1030	691	418	1314	1054	1164	1032	533	564
5	312	521	282	160	167	359	200	366	277	138	214
6	154	296	108	121	75	129	64	137	114	61	80
7	38	84	26	46	36	55	38	67	20	15	35
8	20	23	12	25	17	41	11	10	32	19	21
	5	5	5	8	6	15	1	5	16	14	5
Total	8106	9895	8713	9679	7926	8330	9923	9515	9279	7463	5105
Tonsl	292	353	315	277	249	318	350	344	305	232	186
Sopco	100	100	100	100	100	99	99	100	101	100	100

Catch weights at age (kg)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	0.014	0.015	0.014	0.014	0.015	0.012	0.015	0.014	0.014	0.015	0.015
2	0.027	0.025	0.027	0.025	0.027	0.027	0.026	0.025	0.025	0.026	0.026
3	0.044	0.044	0.044	0.044	0.042	0.046	0.045	0.045	0.044	0.043	0.045
4	0.066	0.066	0.064	0.064	0.065	0.064	0.063	0.064	0.064	0.064	0.064
5	0.086	0.087	0.086	0.086	0.086	0.087	0.085	0.086	0.085	0.085	0.087
6	0.107	0.107	0.106	0.107	0.107	0.107	0.108	0.108	0.108	0.108	0.105
7	0.126	0.126	0.125	0.126	0.126	0.127	0.125	0.124	0.126	0.125	0.127
8	0.144	0.144	0.145	0.145	0.145	0.146	0.141	0.149	0.147	0.15	0.145
+Gp	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153
Sopco	1.0022	1.0034	0.9959	1.0001	0.9956	0.9947	0.9917	1.003	1.0086	1.0042	0.9963

Stock weights at age (kg)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	0.014	0.015	0.014	0.014	0.015	0.012	0.015	0.014	0.014	0.015	0.015
2	0.027	0.025	0.027	0.025	0.027	0.027	0.026	0.025	0.025	0.026	0.026
3	0.044	0.044	0.044	0.044	0.042	0.046	0.045	0.045	0.044	0.043	0.045
4	0.066	0.066	0.064	0.064	0.065	0.064	0.063	0.064	0.064	0.064	0.064
5	0.086	0.087	0.086	0.086	0.086	0.087	0.085	0.086	0.085	0.085	0.087
6	0.107	0.107	0.106	0.107	0.107	0.107	0.108	0.108	0.108	0.108	0.105
7	0.126	0.126	0.125	0.126	0.126	0.127	0.125	0.124	0.126	0.125	0.127
8	0.144	0.144	0.145	0.145	0.145	0.146	0.141	0.149	0.147	0.15	0.145
	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153

Natural Mortality (M) at age

ALL

AGE	
1	0.3
2	0.3
3	0.3
4	0.3
5	0.3
6	0.3
7	0.3
8	0.3
+Gp	0.3

Tables 5.18.17 S and SW Portugal (FU28 & 29): Males - Laurec-Shepherd tuning information

```
 Lowestoft VPA Version 3.1
Log catchability  Terminal Fs derived using    L/S    (without F shrinkage)

Fleet : FROTA DE CRUSTA NEPHROPSmalesPORTUGAL
   7/03/1995  15:30

 NEPHROPSmalesPORTUGAL   INDEXFILESLICING

 CPUE data from file tsmjan.low

 Catch data for  11 years. 1984 to 1994. Ages  1 to   9.

      Fleet          Last  First Last
                  ye year   age   age
 FROTA DE CRU  1984  1994     1     8
 PORTUGUESESU  1990  1994     1     8

 Disaggregated Qs
 Log transformation
 The final F is the (reciprocal variance-weighted) mean of the raised fleet F's.
 No trend in Q (mean used)

 Terminal Fs derived using    L/S    (without F shrinkage)

Tuning converged after   19 iterations

 Regression weights
              0.751  0.82 0.877 0.921  0.954 0.976  0.99 0.997      1     1
Fleet :  PORTUGUESE SURVEYS AUGUST
 Oldest age F = 1.000*average of 3 younger ages.

 Fishing mortalities
    Age        1985  1986  1987  1988   1989  1990  1991  1992   1993  1994

            1 0.236 0.132 0.266 0.147  0.162 0.174 0.243 0.298  0.283 0.242
            2 0.547 0.574 0.443 0.465  0.258 0.483 0.508 0.596  0.779 0.644
            3 0.532 0.778 0.499 0.418  0.542 0.741 0.693 0.649  0.517  0.57
            4 0.646  1.01 0.741 0.337   0.94 0.745 0.908 0.948  0.531 0.611
            5 0.898 0.521 0.463 0.448   0.62 0.393 0.732  0.65  0.342 0.479
            6  1.07 0.529 0.504 0.467  0.874 0.234 0.585 0.607  0.321 0.383
            7 1.034 0.264 0.512 0.307  0.875 0.812 0.463 0.172  0.163 0.347
            8 1.001 0.438 0.493 0.407   0.79  0.48 0.593 0.477  0.275 0.403
 Log catchability residuals
 Fleet : FROTA DE CRUSTACEOS
              1984  1985  1986  1987   1988  1989  1990  1991   1992  1993  1994
            1 -0.52 -0.46 -0.68   0.1  -0.14  0.15 -0.18  0.31    0.4  0.46  0.16
            2 -0.35 -0.51  -0.1 -0.29   0.12 -0.28 -0.06  0.15   0.19  0.58  0.24
            3 -0.25 -0.68  0.07  -0.3  -0.13  0.32  0.23  0.32   0.14  0.03 -0.02
            4 -0.58 -0.66  0.16 -0.07  -0.51  0.71  0.07  0.42   0.35 -0.11 -0.12
            5 -0.45 -0.03 -0.21 -0.25   0.05  0.57 -0.28   0.5   0.26 -0.28 -0.07
            6 -0.01  0.15 -0.17 -0.15   0.13  0.94 -0.77  0.28    0.2 -0.32 -0.26
            7  0.06  0.32 -0.57  0.08  -0.05  1.13  0.58  0.22  -0.73 -0.79 -0.19

Fleet : PORTUGUESESURVEYSAUG

              1990  1991  1992  1994
            1  0.28 -0.07  1.03 -1.24
            2 -0.07  0.43  0.21 -0.57
            3  -0.4 -0.02  0.38  0.03
            4 -0.67 -0.27  0.65  0.27
            5 -0.78 -0.51  0.81  0.45
            6 -0.69 -0.24  0.39  0.53
            7  0.02 -0.89  0.59  0.27

SUMMARY STATISTICS FOR AGE  1
  Fleet       Pred.    sePartia Raise   Slop      Intrcp  se
              log q  (log   F     F              S       Intrcpt
            1 -3.34 0.3750.03550.2071 0.09530.0223-3.339 0.113
            2 -6.49 1.0570.00150.8341-0.34100.3100-6.494 0.474

   Fbar           S   Sig   Sig  Variance ratio
        0.242 0.354 0.439 0.439 1.543



                        SUMMARY STATISTICS FOR AGE  2
  Fleet       Pred.    sePartia Raise   Slop      Intrcp  se
              log q  (log   F     F              S       Intrcpt
            1 -2.44 0.3150.08680.5054 0.08170.0180-2.444 0.095
            2  -5.5 0.4840.00411.1389-0.16500.1370-5.501 0.217

   Fbar           S   Sig   Sig  Variance ratio
        0.644 0.264 0.372 0.372 1.977
```

Tables 5.18.17 cont'd. S and SW Portugal (FU28 & 29): Males - Laurec-Shepherd tuning information

SUMMARY STATISTICS FOR AGE 3

Fleet	Pred. log q	sePartia (log F	Raise F	Slop	Intrcp S	se Intrcpt
1	-2.3	0.289	0.0998	0.5827	0.0493	0.025 -2.305 0.087
2	-5.15	0.351	0.0058	0.5517	0.0991	0.11 -5.148 0.158

Fbar	S	Sig	Sig	Variance ratio
0.57	0.223	0.026	8 0.223	0.014

SUMMARY STATISTICS FOR AGE 4

Fleet	Pred. log q	sePartia (log F	Raise F	Slop	Intrcp S	se Intrcpt
1	-2.14	0.422	0.1179	0.6857	0.0537	0.039 -2.138 0.128
2	-5.14	0.651	0.0058	0.4641	0.246	0.168 -5.143 0.292

Fbar	S	Sig	Sig	Variance ratio
0.611	0.354	0.178	0.354	0.253

SUMMARY STATISTICS FOR AGE 5

Fleet	Pred. log q	sePartia (log F	Raise F	Slop	Intrcp S	se Intrcpt
1	-2.42	0.334	0.0888	0.5136	0.027	0.034 -2.421 0.101
2	-5.34	0.845	0.0048	0.3054	0.337	0.205 -5.345 0.379

Fbar	S	Sig	Sig	Variance ratio
0.479	0.311	0.178	0.311	0.327

SUMMARY STATISTICS FOR AGE 6

Fleet	Pred. log q	sePartia (log F	Raise F	Slop	Intrcp S	se Intrcpt
1	-2.44	0.445	0.0871	0.4977	-0.0217	0.045 -2.441 0.134
2	-5.42	0.632	0.0044	0.2261	0.306	0.092 -5.416 0.284

Fbar	S	Sig	Sig	Variance ratio
0.383	0.364	0.371	0.371	1.041

SUMMARY STATISTICS FOR AGE 7

Fleet	Pred. log q	sePartia (log F	Raise F	Slop	Intrcp S	se Intrcpt
1	-2.64	0.589	0.0717	0.4182	-0.0544	0.058 -2.635 0.178
2	-5.67	0.707	0.0035	0.2648	0.159	0.237 -5.665 0.317

Fbar	S	Sig	Sig	Variance ratio
0.347	0.452	0.225	0.452	0.247

Tables 5.18.18 SW and S Portugal (FU's 28 & 29): Males - XSA tuning information

```
 Lowestoft VPA Version 3.1
Extended Survivors Analysis
Catch data for  11 years. 1984 to 1994. Ages  1 to   9.

      Fleet                      Last    First   Last    Alpha    Beta
                               year year     age     age
FROTA DE CRUSTACEOS            1986    1994       1       8       0       1
PORTUGUESESURVEYSAUGUST        1990    1994       1       8     0.6     0.7

 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years

 Catchability analysis :

      Catchability dependent on stock size for ages <    4

         Regression type = C
         Minimum of    5 points used for regression
         Survivor estimates shrunk to the population mean for ages <  4

      Catchability independent of age for ages >=    6

 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final    5 years or the    5 oldest ages.

      S.E. of the mean to which the estimates  are shrunk =    .300

      Minimum standard error for population
      estimates derived from each fleet =    .300

      Prior weighting applied :
      Fleet  Weight
      FROTA DE  1.00
      PORTUGUE   .10
 Tuning converged after   14 iterations
Regression weights
          0.82   0.877   0.921   0.954   0.976    0.99   0.997       1

 Fishing mortalities
   Age     1986    1987    1988    1989    1990    1991    1992    1993    1994

     1    0.133   0.267   0.148   0.165   0.179   0.258   0.283   0.214   0.128
     2    0.589   0.453    0.47   0.261   0.498   0.534   0.662   0.723   0.428
     3    0.782    0.52   0.432   0.553   0.769    0.74   0.714   0.624   0.493
     4    1.035   0.749   0.357   1.031   0.783   0.999   1.125   0.632   0.881
     5    0.514   0.479   0.452   0.688   0.463   0.813   0.802   0.471   0.649
     6     0.54   0.494   0.493   0.907   0.272   0.787   0.751   0.455   0.636
     7    0.299    0.53   0.296   0.995   0.886   0.584   0.269   0.221   0.591
     8    0.638   0.603   0.429   0.755   0.616   0.705   0.715   0.504   0.632

 XSA population numbers (Thousands)

                                AGE
 YEAR          1       2       3       4       5       6       7       8

    1986    16200    8930    4490    1860     815     301     117      30
    1987    20200   10500    3670    1520     488     361     130      64
    1988    17100   11400    4930    1620     533     224     163      57
    1989    17800   10900    5300    2370     838     251     101      90
    1990    13500   11200    6230    2260     627     312      75      28
    1991    12900    8390    5020    2140     764     292     176      23
    1992    14700    7370    3640    1780     584     251      99      73
    1993    11600    8200    2820    1320     427     194      88      56
    1994    10800    6950    2950    1120     521     198      91      52
```

Estimated population abundance at 1st Jan 1995

0	7010	3350	1330	343	201	78	37

Taper weighted geometric mean of the VPA populations:

14700	9220	4250	1780	651	277	112	48

Standard error of the weighted Log(VPA populations) :

0.194	0.1787	0.2599	0.2495	0.2932	0.2796	0.2739	0.4376

Log catchability residuals.

Fleet : FROTA DE CRUSTACEOS

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	-0.57	0.05	-0.12	0.13	-0.1	0.35	0.31	0.2	-0.35
2	-0.27	-0.49	0.42	-0.44	0.07	0.22	0.29	0.83	-0.72
3	-0.05	-0.24	-0.19	0.1	0.01	0.15	0.12	0.18	-0.11
4	-0.04	-0.29	-0.66	0.57	-0.1	0.29	0.29	-0.15	0.03
5	-0.4	-0.39	-0.11	0.49	-0.3	0.42	0.28	-0.14	0.05
6	-0.32	-0.34	0.02	0.8	-0.79	0.4	0.24	-0.14	0.07
7	-0.8	-0.25	-0.45	0.88	0.29	0.09	-0.65	-0.84	-0.02
8	0.03	-0.07	-0.02	0.57	0.08	0.31	0.25	0.03	0.15

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	4	5	6	7	8
Mean Lo	-1.9387	-2.2577	-2.2853	-2.2853	-2.2853
S.E(Log	0.3627	0.3394	0.4666	0.6019	0.258

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Interce	RSquare	No Pts	Reg s.e	Mean Log q
1	0.85	0.261	4.28	0.32	9	0.32	-3.37
2	2.07	-1.017	-4.73	0.12	9	0.55	-2.42
3	0.74	1.216	3.83	0.76	9	0.17	-2.21

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Interce	RSquare	No Pts	Reg s.e	Mean Q
4	0.61	1.289	4.09	0.63	9	0.21	-1.94
5	0.62	1.196	3.82	0.61	9	0.21	-2.26
6	3.54	-0.885	-6.01	0.02	9	1.68	-2.29
7	1.18	-0.204	2.06	0.16	9	0.72	-2.47
8	0.91	0.614	2.29	0.88	9	0.19	-2.13

Fleet : PORTUGUESESURVEYSAUG

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	99.99	99.99	99.99	99.99	0.45	0.15	1.14	99.99	-1.73
2	99.99	99.99	99.99	99.99	0.01	0.54	0.4	99.99	-0.94
3	99.99	99.99	99.99	99.99	-0.35	0.05	0.46	99.99	-0.16
4	99.99	99.99	99.99	99.99	-0.83	-0.34	0.69	99.99	0.45
5	99.99	99.99	99.99	99.99	-0.86	-0.57	0.85	99.99	0.55
6	99.99	99.99	99.99	99.99	-0.9	-0.2	0.34	99.99	0.74
7	99.99	99.99	99.99	99.99	-0.38	-1.2	0.43	99.99	0.25
8	99.99	99.99	99.99	99.99	-0.05	-0.13	-0.31	99.99	0.7

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	4	5	6	7	8
Mean Lo	-4.7475	-4.9814	-4.9696	-4.9696	-4.9696
S.E(Log	0.7054	0.8341	0.7109	0.7841	0.4495

Tables 5.18.18 cont'd. SW and S Portugal (FU's 28 & 29): Males - XSA tuning information

regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Interce	RSquare	No Pts	Reg s.e	Mean Log q
1	0.1	16.443	9.18	0.99	4	0.01	-6.57
2	0.51	0.451	7.2	0.3	4	0.4	-5.42
3	1.71	-0.599	2.56	0.27	4	0.68	-4.97

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Interce	RSquare	No Pts	Reg s.e	Mean Q
4	-1.86	-1.364	12.53	0.1	4	1.15	-4.75
5	-0.39	-1.325	6.99	0.32	4	0.29	-4.98
6	-0.44	-3.659	5.82	0.77	4	0.14	-4.97
7	-2.48	-1.352	3.3	0.07	4	1.62	-5.19
8	0.9	0.181	4.8	0.65	4	0.49	-4.92

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1993

Fleet	Estimat Survivor	Int s.e	E s	Var Ratio	N	Scaled Weights	Estimated F
FROTA D	4959	0.399	0	0	1	0.115	0.177
PORTUGU	1239	4.377	0	0	1	0.001	0.574
P shr	9223	0.18				0.652	0.099
F shr	3872	0.3				0.231	0.221

Weighted prediction :

Survivo at end	s.e	Ex s.	N	Var Ratio	F
7011	0.14	0.3	4	2.113	0.128

Age 2 Catchability dependent on age and year class strength

Year class = 1992

Fleet		Int s.e	E s	Var Ratio	N	Scaled Weights	Estimated F
FROTA D	3309	0.306	0.392	1.28	2	0.186	0.433
PORTUGU	1309	2.373	0	0	1	0.004	0.863
P shr	4247	0.26				0.463	0.352
F shr	2490	0.3				0.348	0.543

Weighted prediction :

Survivor at end	s.e	Ex s.	N	Var Ratio	F
3354	0.17	0.15	5	0.883	0.428

Age 3 Catchability dependent on age and year class strength

Year class = 1991

Fleet		Int s.e	E s	Var Ratio	N	Scaled Weights	Estimated F
FROTA D	1389	0.235	0.2	0.85	3	0.252	0.477
PORTUGU	1177	1.214	0.218	0.18	2	0.011	0.543
P shr	1781	0.25				0.436	0.39
F shr	854	0.3				0.301	0.69

Weighted prediction :

Survivo at end	s.e	Ex s.	N	Var Ratio	F
1335	0.15	0.14	7	0.913	0.493

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet		Int s.e	E s	Var Ratio	N	Scaled Weights	Estimated F
FROTA D	393	0.212	0.064	0.3	4	0.362	0.804
PORTUGU	526	1.905	0.047	0.02	3	0.005	0.654
F shr	316	0.3				0.633	0.93

Weighted prediction :

Survivo at end	s.e	Ex s.	N	Var Ratio	F
343	0.21	0.07	8	0.35	0.881

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet		Int s.e	E s	Var Ratio	N	Scaled Weights	Estimated F
FROTA D	204	0.207	0.054	0.26	5	0.422	0.644
PORTUGU	333	1.279	0.024	0.02	4	0.008	0.44
F shr	198	0.3				0.569	0.657

Weighted prediction :

Survivo at end	s.e	Ex s.	N	Var Ratio	F
201	0.19	0.03	10	0.152	0.649

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet		Int s.e	E s	Var Ratio	N	Scaled Weights	Estimated F
FROTA D	79	0.23	0.066	0.29	6	0.36	0.627
PORTUGU	134	1.576	0.18	0.11	4	0.008	0.416
F shr	76	0.3				0.632	0.644

Weighted prediction :

Survivo at end	s.e	Ex s.	N	Var Ratio	F
78	0.21	0.03	11	0.168	0.636

Tables 5.18.18 cont'd. SW and S Portugal (FU's 28 & 29): Males - XSA tuning information

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1987

Fleet		Int s.e	E s	Var Ratio	N	Scaled Weights	Estimated F
FROTA D	39	0.248	0.075	0.3	7	0.305	0.575
PORTUGU	46	1.799	0.212	0.12	4	0.007	0.502
F shr	37	0.3				0.688	0.599

Weighted prediction :

Survivo at end	s.e	Ex s.	N	Var Ratio	F
37	0.22	0.04	12	0.162	0.591

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1986

Fleet		Int s.e	E s	Var Ratio	N	Scaled Weights	Estimated F
FROTA D	22	0.215	0.127	0.59	8	0.444	0.607
PORTUGU	36	1.337	0.199	0.15	4	0.013	0.406
F shr	19	0.3				0.543	0.659

Weighted prediction :

Survivo at end	s.e	Ex s.	N	Var Ratio	F
21	0.19	0.07	13	0.383	0.632

Table 5.18.19 SW and S Portugal (FU's 28 & 29): Males - XSA output

Terminal Fs derived using XSA (With F shrinkage)

Fishing mortality (F) at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94
AGE												
1	0.1559	0.2386	0.133	0.2665	0.148	0.1645	0.1788	0.2579	0.283	0.2138	0.1283	0.2083
2	0.4555	0.5464	0.5886	0.4535	0.47	0.2612	0.498	0.5337	0.6618	0.723	0.4284	0.6044
3	0.5794	0.5335	0.7823	0.5198	0.4321	0.5534	0.7693	0.7401	0.7138	0.624	0.4926	0.6101
4	0.4942	0.6436	1.0352	0.7492	0.3571	1.0312	0.7828	0.9994	1.1249	0.6319	0.8813	0.8794
5	0.4288	0.9127	0.5144	0.4792	0.4523	0.6882	0.4632	0.8135	0.8018	0.4707	0.6493	0.6406
6	0.675	1.1575	0.5399	0.4936	0.4926	0.9073	0.2722	0.7869	0.7507	0.4549	0.6356	0.6138
7	0.5495	1.2374	0.2993	0.5303	0.2961	0.9947	0.8856	0.5835	0.2689	0.2215	0.5908	0.3604
8	0.5527	0.9122	0.6382	0.6032	0.4291	0.7547	0.6161	0.7053	0.715	0.5037	0.6321	0.6169
+gp	0.5527	0.9122	0.6382	0.6032	0.4291	0.7547	0.6161	0.7053	0.715	0.5037	0.6321	
FBAR 1- 6	0.4648	0.672	0.5989	0.4936	0.392	0.601	0.4941	0.6886	0.7227	0.5197	0.5359	

Terminal Fs derived using XSA (With F shrinkage)

Stock number at age (start of year) Numbers*10**-3

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 84-92	AMST 84-92
AGE														
1	16528	15299	16161	20152	17105	17754	13537	12881	14690	11614	10759	0	15876	16012
2	9092	10477	8928	10481	11436	10928	11158	8386	7373	8201	6948	7011	9712	9807
3	5043	4271	4494	3671	4934	5295	6235	5024	3643	2818	2948	3354	4672	4735
4	2238	2093	1856	1523	1617	2373	2256	2140	1775	1322	1119	1335	1964	1986
5	1039	1011	815	488	533	838	627	764	584	427	521	343	720	744
6	365	502	301	361	224	251	312	292	251	194	198	201	309	318
7	104	137	117	130	163	101	75	176	99	88	91	78	119	123
8	55	45	30	64	57	90	28	23	73	56	52	37	47	51
+gp	13	9	12	20	20	32	2	11	36	40	12	25		
TOTAL	34478	33844	32713	36891	36090	37664	34230	29697	28524	24760	22648	12384		

Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTAL BIOM	TOTSPBIO SSB	LANDINGS	YIELD/SSB	SOPCOPAC	FBAR (1-6)
1984	16528	1000	526	292	0.555	1.002	0.465
1985	15299	988	489	353	0.722	1.003	0.672
1986	16161	903	431	315	0.731	0.996	0.599
1987	20152	913	405	277	0.685	1.000	0.494
1988	17105	975	472	249	0.528	0.996	0.392
1989	17754	1029	531	318	0.599	0.995	0.601
1990	13537	1008	521	350	0.672	0.992	0.494
1991	12881	880	455	344	0.756	1.003	0.689
1992	14690	776	361	305	0.844	1.009	0.723
1993	11614	679	316	232	0.734	1.004	0.520
1994	10759	631	305	186	0.610	0.996	0.536
Arith. Mean	15135	889	437	293		0.6759	0.5621
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)			

Table 5.18.20 SW and S Portugal (FU's 28 & 29): Female - VPA input

Catch numbers at age Numbers*10**-3

Y	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	2549	3215	2172	6418	2762	2536	2338	3500	3415	2827	1870
2	1102	1198	1155	1546	1327	744	1539	1241	1241	1467	1252
3	1185	960	1074	1126	1286	889	1269	621	703	644	808
4	921	714	675	666	766	591	537	293	531	350	541
5	712	505	590	419	431	488	351	208	467	213	301
6	362	212	237	215	342	227	362	166	263	211	196
7	108	141	114	106	168	216	186	85	119	160	166
8	56	45	105	67	50	168	185	104	66	96	87
9	26	21	55	165	36	120	95	28	56	56	70
10	15	12	26	90	22	38	48	34	45	44	29
+	19	9	12	161	54	113	49	79	154	129	59
TOTALNUM	7055	7032	6215	10979	7244	6130	6959	6359	7060	6197	5379
TONSLAND	169	156	150	232	171	151	174	134	165	117	133
SOPCOF %	100	99	100	101	99	100	101	101	102	82	100

Catch weights at age (kg)

Y	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
1	0.014	0.015	0.015	0.014	0.015	0.013	0.015	0.014	0.014	0.015	0.016
2	0.022	0.021	0.021	0.021	0.022	0.021	0.021	0.021	0.021	0.021	0.021
3	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.025	0.026
4	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.031	0.030	0.030
5	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
6	0.040	0.040	0.039	0.040	0.039	0.040	0.040	0.040	0.040	0.040	0.040
7	0.044	0.045	0.046	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
8	0.050	0.050	0.049	0.050	0.050	0.050	0.049	0.050	0.049	0.049	0.049
9	0.054	0.054	0.055	0.055	0.055	0.055	0.055	0.053	0.055	0.055	0.055
10	0.060	0.060	0.059	0.060	0.060	0.061	0.060	0.061	0.060	0.060	0.060
+	0.070	0.067	0.071	0.071	0.072	0.070	0.067	0.070	0.074	0.071	0.072
SOP	1.000	0.994	0.995	1.014	0.990	1.003	1.011	1.015	1.023	0.821	0.997

Natural Mortality (M) at age

Yall	
AGE	
1	0.3
2	0.3
3	0.2
4	0.2
5	0.2
6	0.2
7	0.2
8	0.2
9	0.2
10	0.2
+	0.2

Proportion mature at age

Yall	
AGE	
1	0
2	0.5
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
+	1

Tables 5.18.21 S and SW Portugal (FU28 & 29): Females - Laurec-Shepherd tuning information


```
 Lowestoft VPA Version 3.1
9/03/1995  16:01
 CPUE data from file tsfjan.low
 Catch data for  11 years. 1984 to 1994. Ages  1 to   9.

      Flee   First   Last      First     Last
             year   year       age       age
 FROTADECR     1984      1994         1         8
 PORTUGUES     1990      1994         1         8

 Disaggregated Qs
 Log transformation
 The final F is the (reciprocal variance-weighted) mean of the raised fleet F's.
 No trend in Q (mean used)

 Terminal Fs derived using    L/S    (without F shrinkage)

 Tuning converged after   13 iterations

 Regression weights
              0.751      0.82     0.877     0.921     0.954     0.976      0.99     0.997         1         1

 Oldest age F = 1.000*average of 3 younger ages.
```

Tables 5.18.21 cont'd. S and SW Portugal (FU28 & 29): Females - Laurec-Shepherd tuning information

Fishing mortalities

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.321	0.218	0.607	0.298	0.310	0.308	0.382	0.373	0.305	0.329
2	0.177	0.194	0.253	0.254	0.129	0.335	0.284	0.240	0.289	0.228
3	0.199	0.238	0.293	0.345	0.270	0.336	0.218	0.258	0.189	0.256
4	0.215	0.209	0.227	0.332	0.264	0.260	0.120	0.294	0.198	0.239
5	0.435	0.276	0.194	0.225	0.365	0.247	0.152	0.284	0.183	0.261
6	0.277	0.375	0.153	0.240	0.178	0.509	0.177	0.291	0.200	0.256
7	0.248	0.235	0.287	0.172	0.235	0.216	0.212	0.186	0.289	0.239
8	0.320	0.296	0.211	0.212	0.259	0.324	0.180	0.254	0.224	0.252

Log catchability residuals

Fleet : FROTADECRUSTACEOS

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	-0.58	-0.61	-0.63	0.46	0.18	0.33	-0.06	0.31	0.16	0.07	0
2	-0.62	-0.84	-0.39	-0.05	0.39	-0.18	0.39	0.38	0.08	0.39	0
3	-0.34	-0.84	-0.3	-0.02	0.58	0.45	0.28	0	0.04	-0.16	0
4	0.32	-0.7	-0.36	-0.2	0.61	0.49	0.09	-0.53	0.24	-0.04	0
5	0.42	-0.08	-0.17	-0.45	0.14	0.73	-0.05	-0.38	0.12	-0.2	0
6	0.14	-0.51	0.16	-0.67	0.22	0.02	0.69	-0.21	0.16	-0.1	0
7	0.34	-0.55	-0.24	0.03	-0.05	0.37	-0.09	0.04	-0.22	0.34	0

Fleet : PORTUGUESESURVEYSAUG

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Tables 5.18.21 cont'd. S and SW Portugal (FU28 & 29): Females - Laurec-Shepherd tuning information

SUMMARY STATISTICS FOR AGE 1

Fleet	Pred. log q	se (log q)	Partial F	Raised F	Slope	se Slope	Intrcpt	se Intrcpt
1	-9.78	0.376	0.3286	0.3286	6.01E-02	3.33E-02	-9.783	0.113

2Insufficient data points for this fleet at this age

Fbar	Sigma	Sigma(e	Sigma(o	Variance ratio
0.329	0.376	0	0.376	0

SUMMARY STATISTICS FOR AGE 2

Fleet	Pred. log q	se (log q)	Partial F	Raised F	Slope	se Slope	Intrcpt	se Intrcpt
1	-10.15	0.412	0.2279	0.2279	8.72E-02	3.11E-02	-10.149	0.124

2Insufficient data points for this fleet at this age

Fbar	Sigma	Sigma(e	Sigma(o	Variance ratio
0.228	0.412	0	0.412	0

SUMMARY STATISTICS FOR AGE 3

Fleet	Pred. log q	se (log q)	Partial F	Raised F	Slope	se Slope	Intrcpt	se Intrcpt
1	-10.03	0.376	0.2556	0.2556	3.89E-02	3.67E-02	-10.034	0.114

2Insufficient data points for this fleet at this age

Fbar	Sigma	Sigma(e	Sigma(o	Variance ratio
0.256	0.376	0	0.376	0

Tables 5.18.21 cont'd. S and SW Portugal (FU28 & 29): Females - Laurec-Shepherd tuning information

```
SUMMARY STATISTICS FOR AGE  4
  Fleet    Pred.        se    Partial    Raised      Slope        se  Intrcpt     se
           log q      (log q)    F          F                    Slope          Intrcpt
         1    -10.1     0.405    0.2392    0.2392  1.34E-02  4.17E-02   -10.101     0.122
    2Insufficient data points for this fleet at this age

   Fbar        Sigma   Sigma(e   Sigma(o Variance ratio
     0.239     0.405         0     0.405         0

SUMMARY STATISTICS FOR AGE  5
  Fleet    Pred.        se    Partial    Raised      Slope        se  Intrcpt     se
           log q      (log q)    F          F                    Slope          Intrcpt
         1    -10.01     0.339    0.2607    0.2607 -1.46E-02  3.48E-02   -10.015     0.102
    2Insufficient data points for this fleet at this age

   Fbar        Sigma   Sigma(e   Sigma(o Variance ratio
     0.261     0.339         0     0.339         0

SUMMARY STATISTICS FOR AGE  6
  Fleet    Pred.        se    Partial    Raised      Slope        se  Intrcpt     se
           log q      (log q)    F          F                    Slope          Intrcpt
         1    -10.03     0.366    0.2563    0.2563  2.10E-02  3.72E-02   -10.032      0.11
    2Insufficient data points for this fleet at this age
   Fbar        Sigma   Sigma(e   Sigma(o Variance ratio
     0.256     0.366         0     0.366         0

SUMMARY STATISTICS FOR AGE  7
  Fleet    Pred.        se    Partial    Raised      Slope        se  Intrcpt     se
           log q      (log q)    F          F                    Slope          Intrcpt
         1    -10.1      0.27    0.2394    0.2394  1.90E-02  2.72E-02     -10.1     0.082
    2Insufficient data points for this fleet at this age
   Fbar        Sigma   Sigma(e   Sigma(o Variance ratio
     0.239      0.27         0      0.27         0
```

Table 5.18.22 SW and S Portugal (FU'S 28 & 29): Females - XSA tuning information

Lowestoft VPA Version 3.1
Extended Survivors Analysis

Catch data for 11 years. 1984 to 1994. Ages 1 to 9.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FROTADECR	1987	1994	1	8	0	1
PORTUGUES	1990	1994	1	8	0.67	0.7

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 6

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = .300

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting applied :

Fleet	Weight
FROTADEC	.50
PORTUGUE	.10

Tuning converged after 37 iterations

Regression weights

0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1987	1988	1989	1990	1991	1992	1993	1994
1	0.611	0.304	0.315	0.31	0.393	0.38	0.347	0.367
2	0.255	0.253	0.131	0.34	0.284	0.248	0.295	0.27
3	0.291	0.35	0.269	0.344	0.223	0.258	0.196	0.262
4	0.236	0.329	0.268	0.258	0.123	0.301	0.197	0.252
5	0.187	0.236	0.362	0.252	0.15	0.295	0.189	0.26
6	0.154	0.229	0.188	0.502	0.181	0.287	0.21	0.267
7	0.321	0.174	0.222	0.232	0.207	0.191	0.284	0.254
8	0.254	0.246	0.263	0.301	0.196	0.246	0.233	0.246

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8
1987	16300	7590	4930	3500	2720	1660	426	330
1988	12300	6560	4810	3020	2260	1840	1170	253
1989	10900	6700	4170	2780	1780	1460	1200	802
1990	10200	5900	4810	2610	1740	1010	993	788
1991	12500	5550	3440	2790	1650	1110	502	645
1992	12500	6250	3420	2250	2020	1160	755	334
1993	11200	6350	3990	2160	1370	1230	715	511
1994	7080	5860	3870	2690	1450	925	818	440

Estimated population abundance at 1st Jan 1995

0.00E+00	3.64E+03	3.66E+03	2.44E+03	1.71E+03	9.18E+02	5.80E+02	5.19E+02

Taper weighted geometric mean of the VPA populations:

11700	6630	4470	2880	1850	1180	713	420

Standard error of the weighted Log(VPA populations) :

0.218	0.134	0.204	0.206	0.233	0.265	0.387	0.496

Table 5.18.22 cont'd. SW and S Portugal (FU'S 28 & 29): Females - XSA tuning information

Log catchability residuals.

Fleet : FROTADECRUSTACEOS

Age	1987	1988	1989	1990	1991	1992	1993	1994
1	0.24	-0.02	0.13	-0.27	0.12	-0.04	-0.02	-0.11
2	-0.25	0.18	-0.37	0.2	0.17	-0.1	0.19	-0.04
3	-0.18	0.44	0.28	0.15	-0.14	-0.12	-0.27	-0.13
4	-0.26	0.5	0.41	-0.01	-0.6	0.17	-0.14	-0.04
5	-0.48	0.18	0.72	-0.02	-0.39	0.15	-0.17	0
6	-0.69	0.14	0.05	0.64	-0.22	0.11	-0.09	0.01
7	0.04	-0.14	0.21	-0.13	-0.09	-0.3	0.22	-0.04
8	-0.2	0.21	0.38	0.13	-0.14	-0.04	0.02	-0.07

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6	7	8
Mean Log	-9.5761	-9.945	-9.8834	-10.0112	-10.0219	-10.0033	-10.0033	-10.0033
S.E(Log q	0.1573	0.2216	0.2521	0.3574	0.3726	0.3683	0.1814	0.1959

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.7	1.954	9.5	0.88	8	0.09	-9.58
	-2.62	-1.767	5.61	0.04	8	0.51	-9.95
3	0.54	1.351	9.17	0.6	8	0.13	-9.88
4	1.11	-0.098	10.24	0.13	8	0.43	-10.01
5	1.15	-0.19	10.4	0.22	8	0.46	-10.02
6	2.46	-1.004	14.19	0.08	8	0.91	-10
7	0.99	0.063	9.99	0.81	8	0.19	-10.03
8	0.87	0.813	9.49	0.88	8	0.17	-9.97

Fleet : PORTUGUESESURVEYSAUG

Age	1987	1988	1989	1990	1991	1992	1993	1994
1	99.99	99.99	99.99	0.35	0.12	0.88	99.99	-1.34
2	99.99	99.99	99.99	0.06	0.4	0.21	99.99	-0.67
3	99.99	99.99	99.99	-0.35	0.24	0.35	99.99	-0.24
4	99.99	99.99	99.99	-0.42	-0.17	0.55	99.99	0.03
5	99.99	99.99	99.99	-0.77	-0.08	0.42	99.99	0.4
6	99.99	99.99	99.99	-0.17	-0.4	0.29	99.99	0.28
7	99.99	99.99	99.99	-1.39	0.16	-0.12	99.99	-0.1
8	99.99	99.99	99.99	-1.11	-1.25	0.77	99.99	0.03

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6	7	8
Mean Log	-5.9658	-6.7389	-6.6526	-6.5048	-6.5028	-6.3624	-6.3624	-6.3624
S.E(Log q	0.9547	0.4706	0.3475	0.4131	0.5582	0.3437	0.8098	1.06

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.24	3.044	8.46	0.89	4	0.12	-5.97
2	-9.9	-0.162	27.89	0	4	5.68	-6.74
3	-1.07	-2.725	9.96	0.47	4	0.21	-6.65
4	-0.4	-1.806	8.4	0.46	4	0.13	-6.5
5	1.09	-0.027	6.42	0.05	4	0.75	-6.5
6	3.1	-0.286	5.12	0.01	4	1.28	-6.36
7	-1.1	-1.785	6.5	0.27	4	0.58	-6.72
8	-0.71	-4.993	5.91	0.81	4	0.23	-6.74

Table 5.18.22 cont'd. SW and S Portugal (FU'S 28 & 29): Females - XSA tuning information

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FROTADECR	3255	0.424	0	0	1	0.256	0.402
PORTUGUES	953	3.378	0	0	1	0.004	0.989
F shrin	3805	0.3				0.74	0.353

Weighted prediction :

Survivors at end of	In s.e	Ext s.e	N	Var Ratio	F
3635	0.25	0.12	3	0.484	0.367

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FROTADECR	3548	0.304	0.013	0.04	2	0.389	0.277
PORTUGUES	1876	1.666	0	0	1	0.015	0.472
F shrin	3801	0.3				0.597	0.261

Weighted prediction :

Survivors at end of	In s.e	Ext s.e	N	Var Ratio	F
3662	0.22	0.06	4	0.28	0.27

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FROTADECR	2429	0.254	0.101	0.4	3	0.452	0.263
PORTUGUES	2051	1.172	0.273	0.23	2	0.026	0.305
F shrin	2470	0.3				0.522	0.259

Weighted prediction :

Survivors at end of	In s.e	Ext s.e	N	Var Ratio	F
2440	0.2	0.05	6	0.252	0.262

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FROTADECR	1541	0.232	0.079	0.34	4	0.482	0.276
PORTUGUES	1874	1.08	0.057	0.05	3	0.025	0.232
F shrin	1886	0.3				0.493	0.231

Weighted prediction :

Survivors at end of	In s.e	Ext s.e	N	Var Ratio	F
1711	0.19	0.06	8	0.339	0.252

Table 5.18.22 cont'd. SW and S Portugal (FU'S 28 & 29): Females - XSA tuning information

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FROTADECR	861	0.221	0.068	0.31	5	0.479	0.275
PORTUGUES	1334	0.895	0.017	0.02	4	0.03	0.186
F shrin	955	0.3				0.491	0.251

Weighted prediction :

Survivors at end of	In s.e	Ext s.e	N	Var Ratio	F
918	0.18	0.04	10	0.239	0.26

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FROTADECR	584	0.216	0.063	0.29	6	0.467	0.265
PORTUGUES	789	0.73	0.079	0.11	4	0.047	0.203
F shrin	560	0.3				0.486	0.275

Weighted prediction :

Survivors at end of	In s.e	Ext s.e	N	Var Ratio	F
580	0.18	0.04	11	0.225	0.267

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1987

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FROTADECR	472	0.199	0.092	0.46	7	0.53	0.276
PORTUGUES	472	0.864	0.16	0.19	4	0.024	0.276
F shrin	585	0.3				0.446	0.228

Weighted prediction :

Survivors at end of	In s.e	Ext s.e	N	Var Ratio	F
519	0.17	0.07	12	0.391	0.254

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1986

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FROTADECR	296	0.194	0.072	0.37	8	0.541	0.236
PORTUGUES	293	0.858	0.166	0.19	4	0.023	0.238
F shrin	265	0.3				0.436	0.26

Weighted prediction :

Survivors at end of	In s.e	Ext s.e	N	Var Ratio	F
282	0.17	0.05	13	0.279	0.246

Tables 5.18.23 SW and S Portugal (FU's 28 & 29): Females - XSA output

Terminal Fs derived using XSA (With F shrinkage)
Fishing mortality (F) at age

YEA	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94
AGE												
1	0.242	0.322	0.220	0.611	0.304	0.315	0.310	0.393	0.380	0.348	0.367	0.365
2	0.153	0.181	0.192	0.255	0.253	0.131	0.340	0.284	0.248	0.295	0.270	0.271
3	0.234	0.194	0.245	0.291	0.350	0.269	0.345	0.223	0.258	0.196	0.262	0.239
4	0.439	0.216	0.203	0.236	0.329	0.268	0.258	0.123	0.302	0.197	0.252	0.250
5	0.549	0.460	0.279	0.187	0.236	0.362	0.253	0.150	0.295	0.189	0.260	0.248
6	0.370	0.309	0.407	0.154	0.229	0.188	0.502	0.181	0.287	0.210	0.267	0.255
7	0.397	0.240	0.272	0.321	0.174	0.222	0.232	0.207	0.191	0.284	0.254	0.243
8	0.401	0.285	0.283	0.254	0.246	0.263	0.301	0.196	0.246	0.233	0.246	0.242
+gp	0.401	0.285	0.283	0.254	0.246	0.263	0.301	0.196	0.246	0.233	0.246	
FBAR 1-7	0.341	0.274	0.260	0.294	0.268	0.251	0.320	0.223	0.280	0.246	0.276	

Stock number at age (start of year) Numbers*10**-3

YEA	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 84-92	AMST 84-92
AGE														
1	13756	13585	12764	16312	12254	10914	10203	12503	12541	11190	7080	0	12655	12759
2	8576	7997	7297	7587	6560	6701	5903	5546	6250	6351	5857	3635	6871	6935
3	6273	6024	5463	4929	4813	4170	4813	3440	3418	3994	3873	3662	4717	4816
4	2867	4064	4063	3501	3017	2777	2610	2792	2255	2162	2687	2440	3050	3105
5	1863	1514	2681	2716	2264	1777	1739	1651	2021	1365	1454	1711	1985	2025
6	1293	881	783	1661	1845	1464	1013	1106	1163	1232	925	918	1201	1245
7	364	731	529	426	1166	1201	993	502	755	715	818	580	681	741
8	188	200	471	330	253	802	788	645	334	511	440	519	389	446
+gp	199	186	415	2039	564	1286	812	870	1284	1211	795	791		
. TOTAL	35380	35183	34468	39502	32735	31092	28873	29055	30021	28732	23929	14256		

Summary (with SOP correction)
Terminal Fs derived using XSA (With F shrinkage)

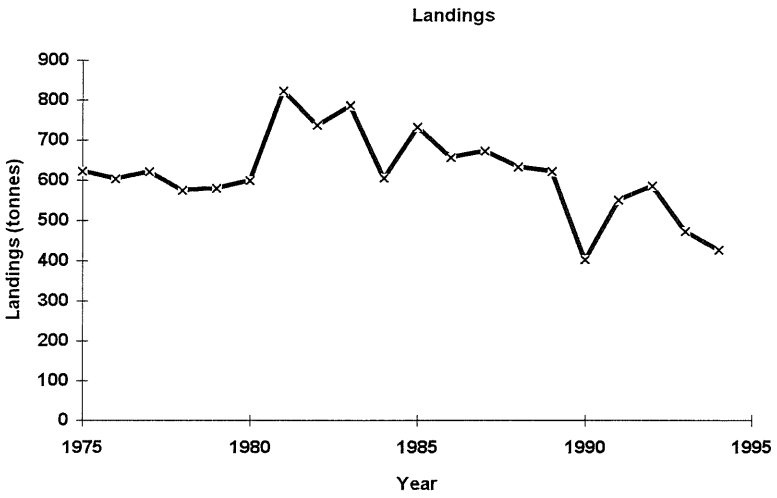
	RECRUITS Age 1	TOTALBIO	TOTSPB	LANDIN	YIELD/S	SOPCOF	FBAR 1- 7
1984	13756	785	437	169	0.3864	1.0003	0.3406
1985	13585	787	449	156	0.3472	0.9938	0.2744
1986	12764	801	478	150	0.3141	0.9953	0.2597
1987	16312	958	579	232	0.401	1.0137	0.2936
1988	12254	788	475	171	0.3599	0.9901	0.2679
1989	10914	771	499	151	0.3023	1.003	0.2505
1990	10203	721	443	174	0.3927	1.0112	0.3198
1991	12503	688	409	134	0.3277	1.0149	0.2231
1992	12541	736	436	165	0.3784	1.0233	0.2802
1993	11190	574	343	117	0.3413	0.8211	0.2455
1994	7080	612	390	133	0.3411	0.997	0.2758
Arith. Mean	12100	747	449	159	.3538		.2756
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)			

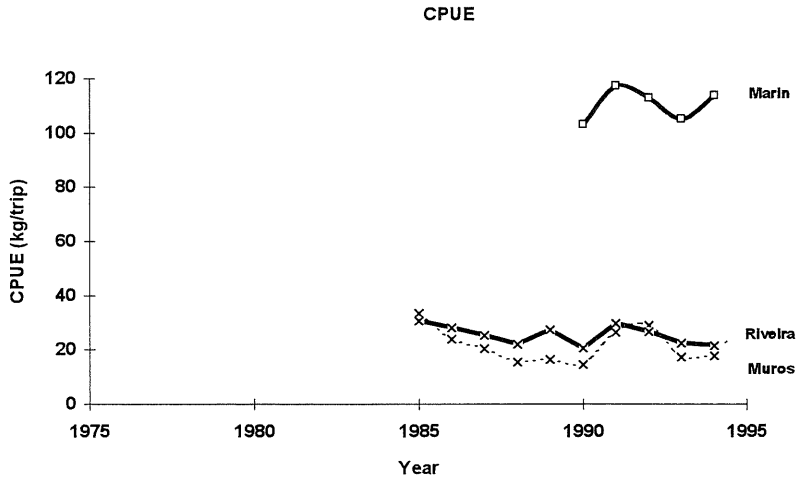
Table 5.18.24 Nephrops Landings (tonnes) by Functional Unit plus other rectangles in Management Area Q (IXa)

Year	FU 26	FU 27	FU 28&29	FU 30	Other	Total
1985	731	15	509	257		1512
1986	655	37	465	221		1378
1987	671	71	509	302		1553
1988	631	96	420	139		1286
1989	620	88	469	174		1351
1990	401	48	524	220		1193
1991	549	54	478	226		1307
1992	584	52	470	243		1349
1993	472	50	376	160		1058
1994*	426	22	318	107		873

Table 5.18.25 Total Nephrops Landings (tonnes) by country in Management Area Q (IXa)

Year	Portugal	Spain	Total
1985	524	1007	1531
1986	502	878	1380
1987	580	973	1553
1988	516	779	1295
1989	557	800	1357
1990	572	621	1193
1991	533	774	1307
1992	522	827	1349
1993	426	632	1058
1994	340	533	873





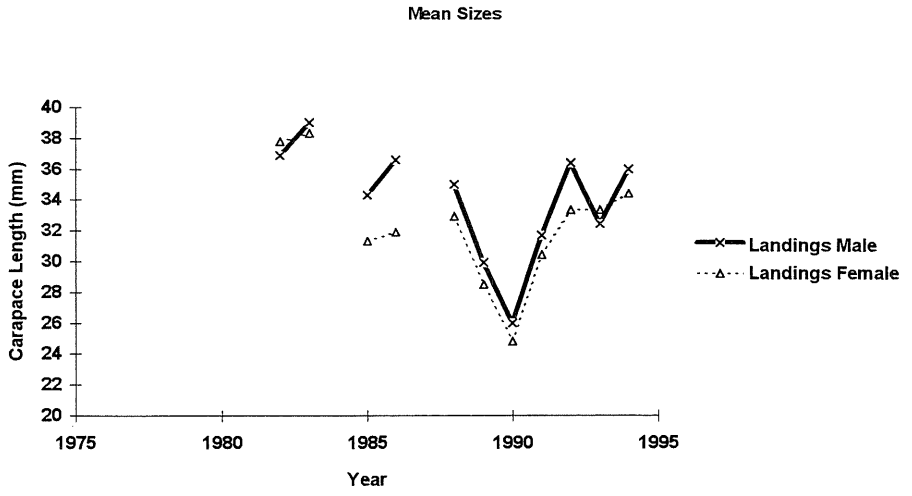


Figure 5.18.1 West Galicia (FU26): Long term trends in landings (tonnes), CPUE from home ports Muros, Riveira and Marin (kg/trip) and mean sizes (mm CL) in landings

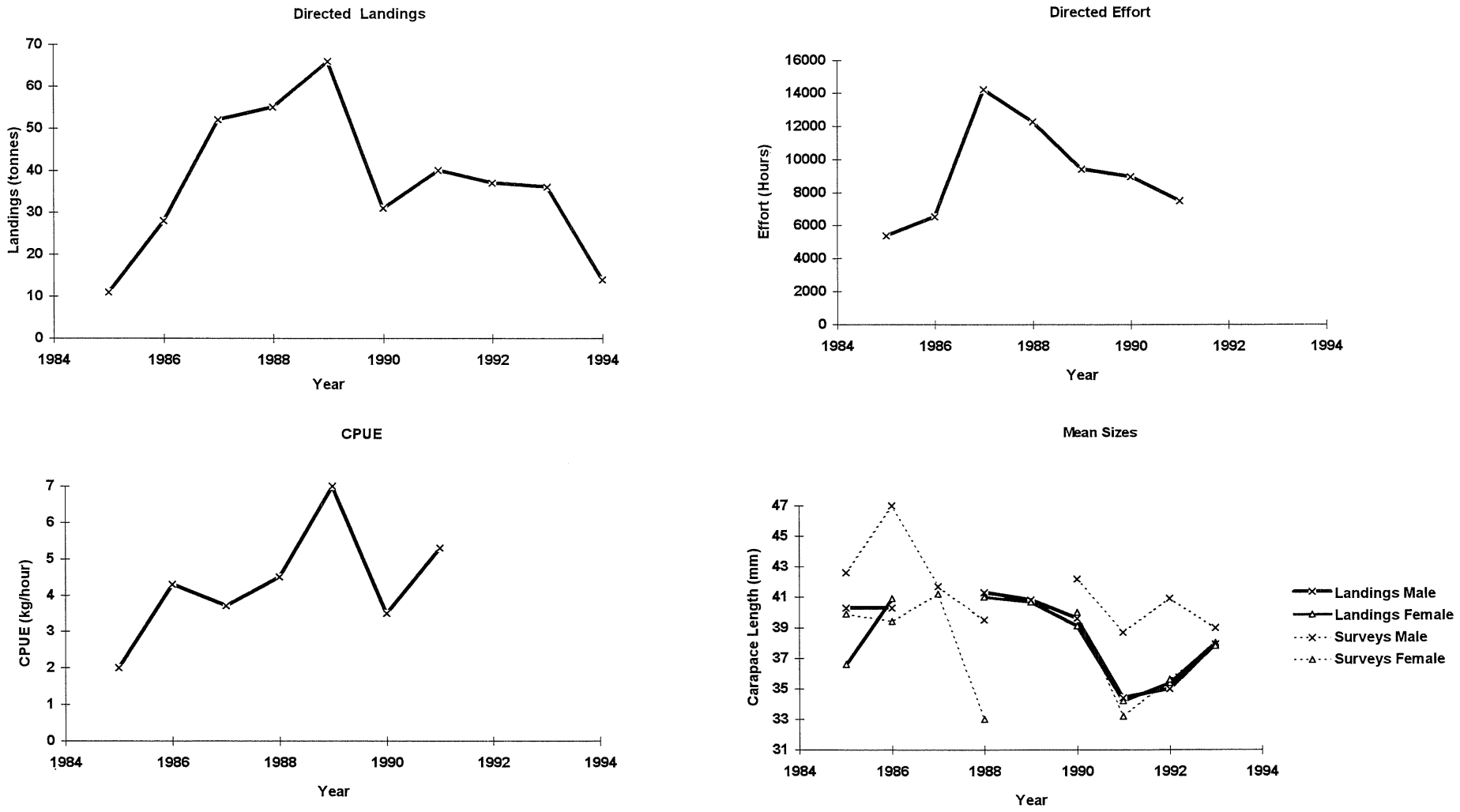
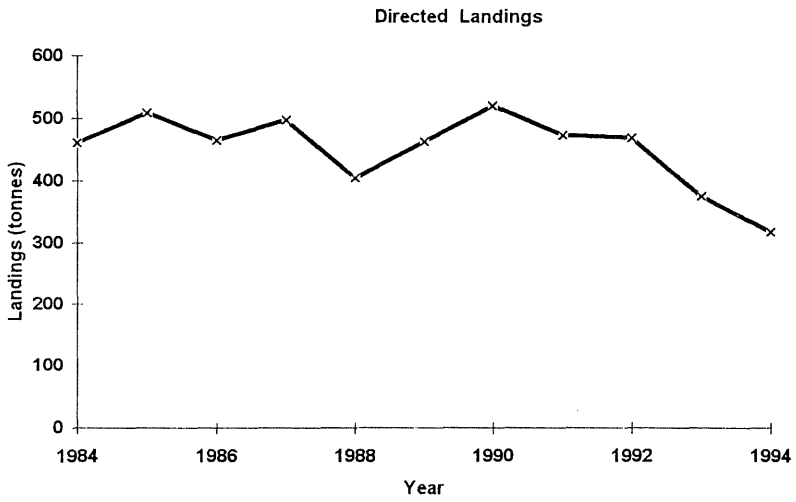
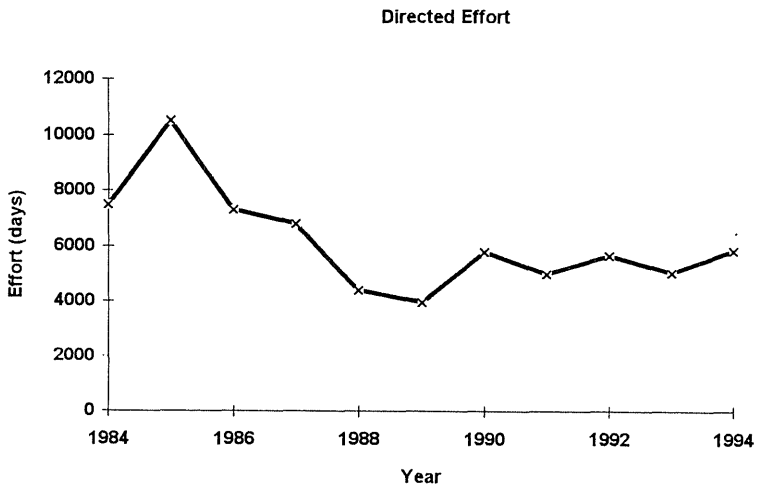
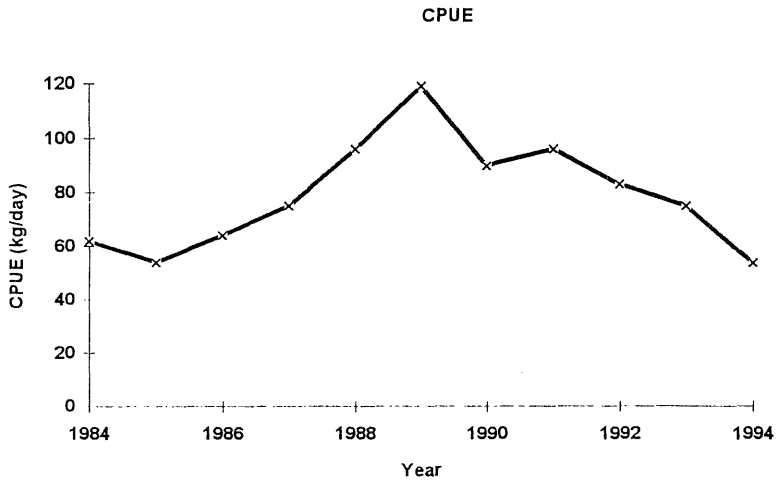


Figure 5.18.2 North Portugal (FU27): Long term trends in directed trawl landings (tonnes), effort (hours), CPUE (kg/hour) and mean sizes (mm CL) in the landings







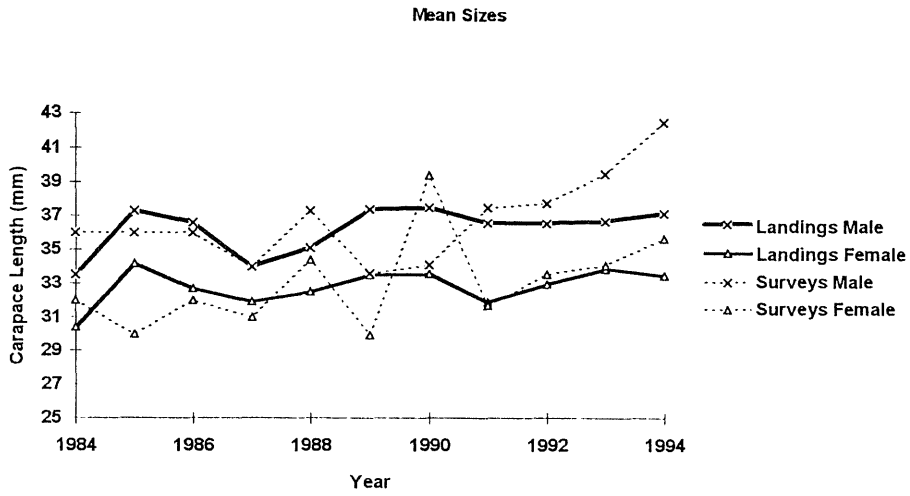


Figure 5.18.3 SW and S Portugal (FU's 28 and 29): Long term trends in directed landings (tonnes), effort (days), CPUE (kg/day) and mean sizes (mm CL) in the landings

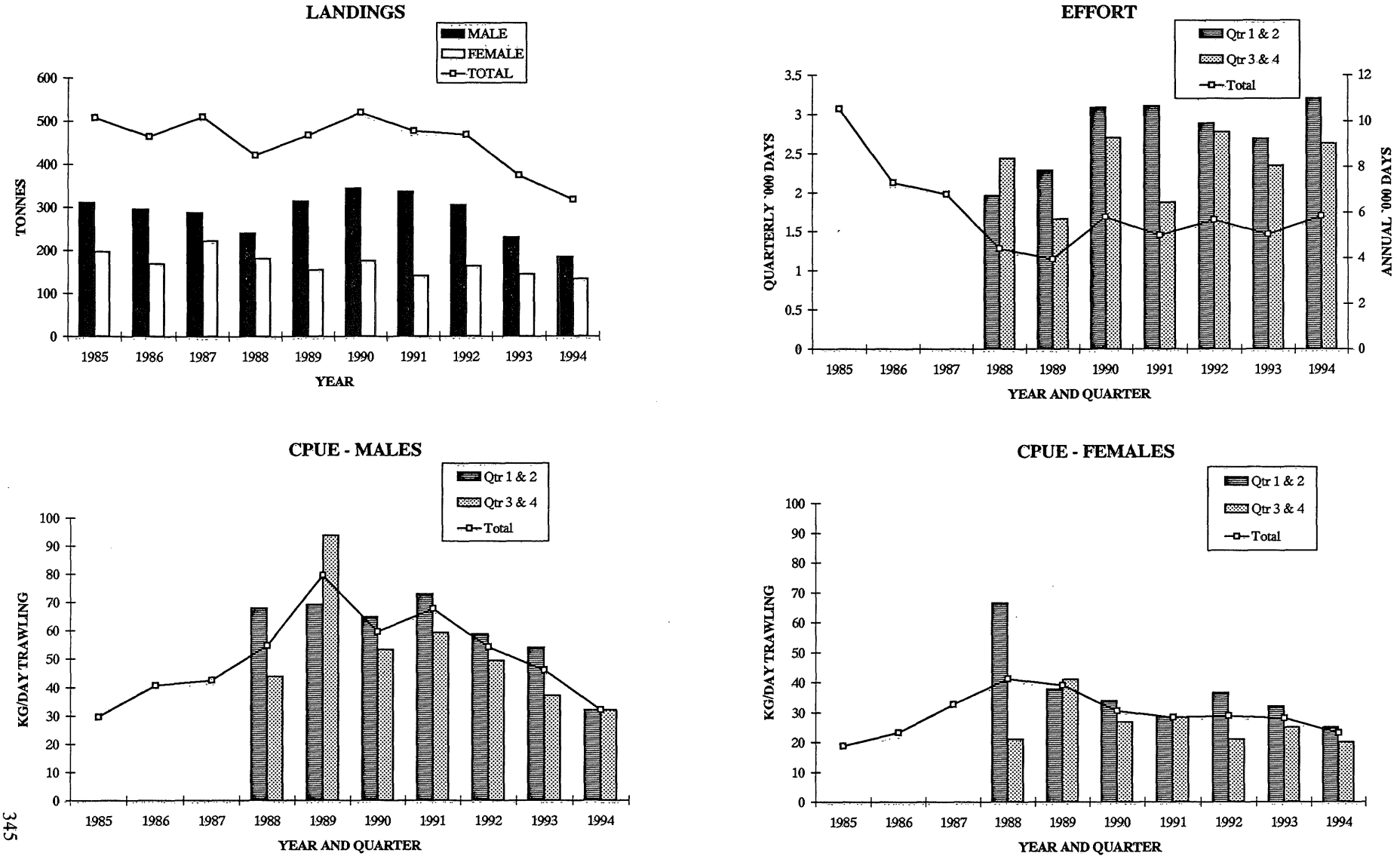
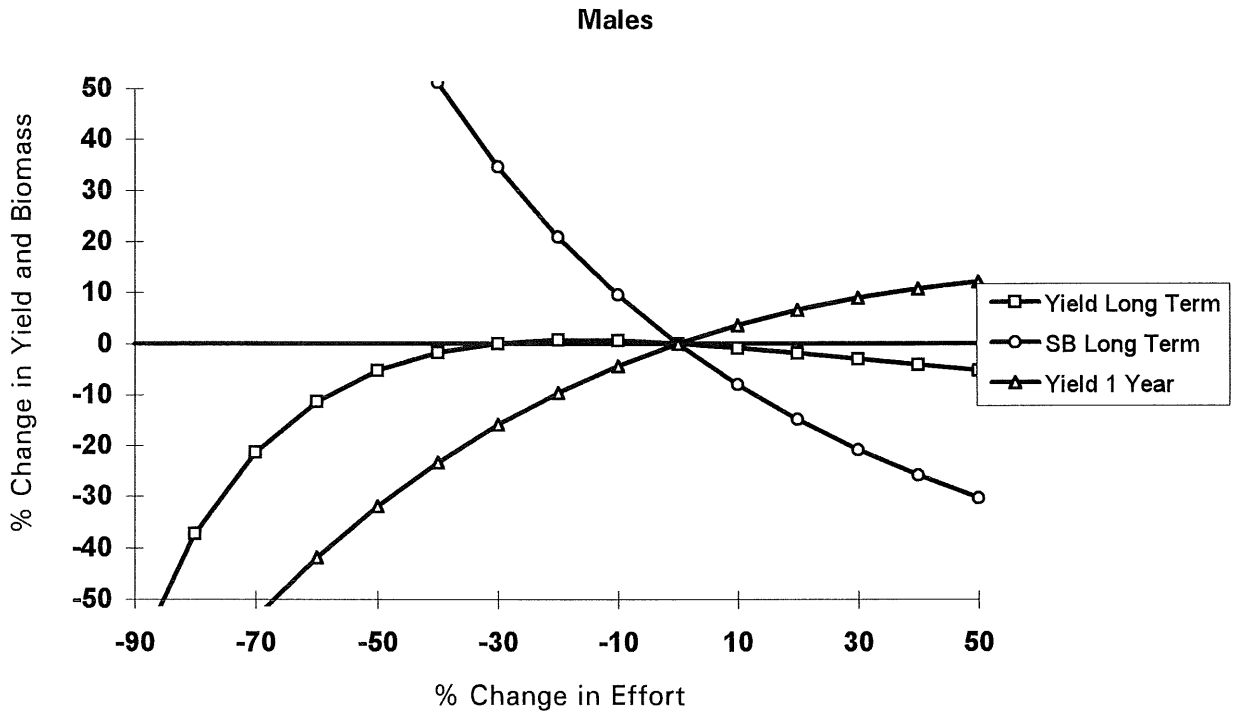


Figure 5.18.4. SW and S Portugal (functional unit 28-29) : trends in landings,effort and CPUE by quarter and sex from Portuguese Nephrops trawlers.



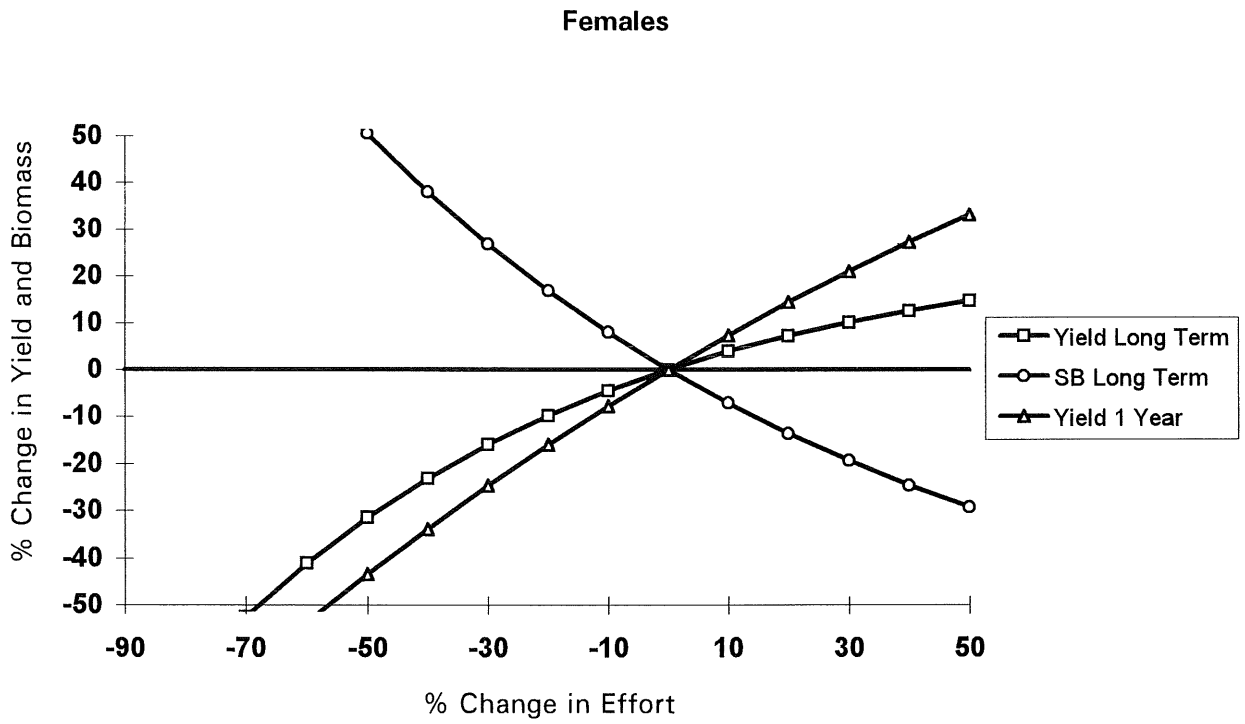


Figure 5.18.5 SW and S Portugal (FU's 28 and 29): Percentage changes in long term landings and stock biomass, and short term landings following various changes in fishing effort. Males and females shown separately

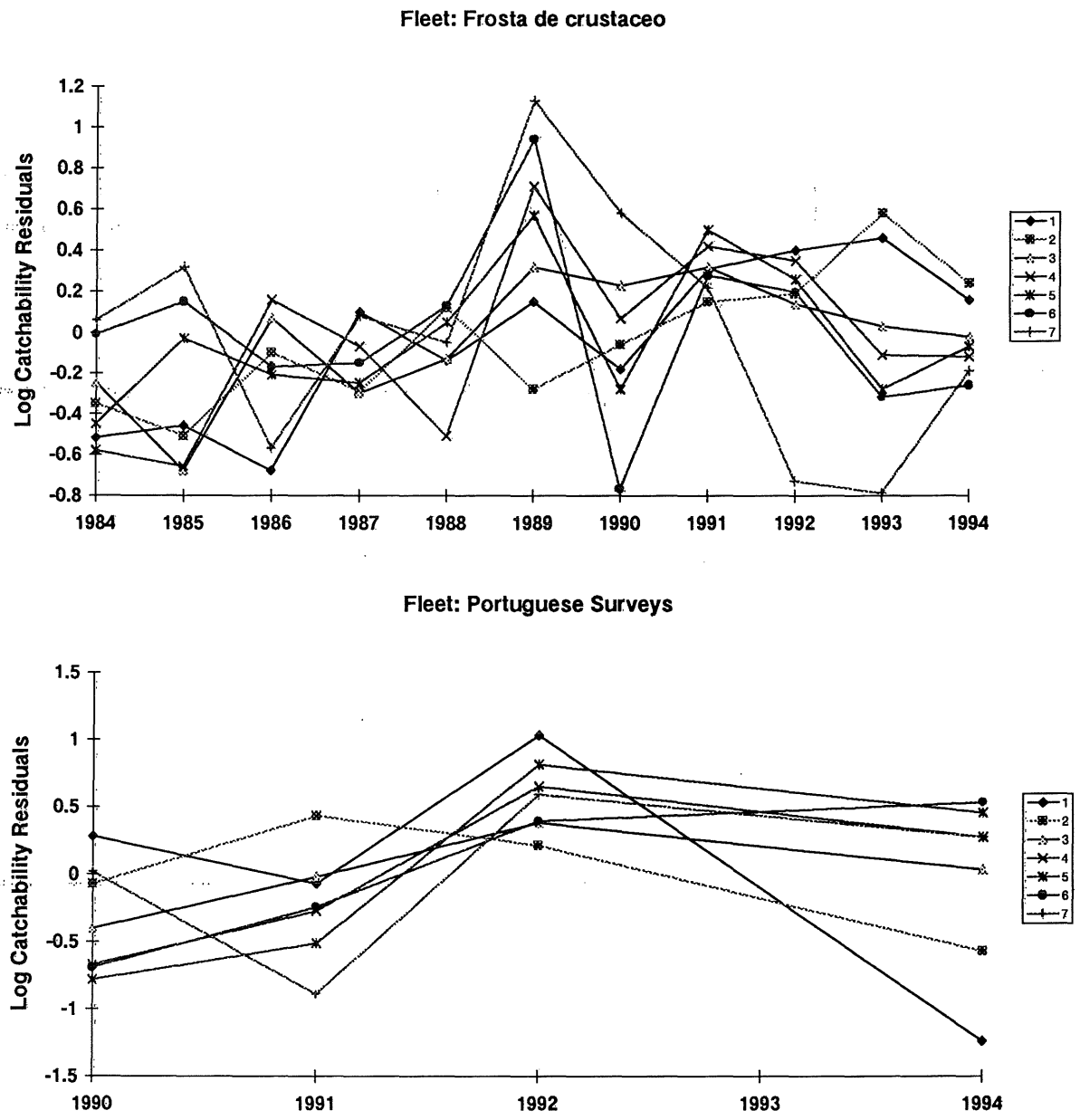


Figure 5.18.6 SW and S Portugal (FU's 28 and 29): Males - log catchability residuals for fleets 1 and 2 from Laurec-Shepherd

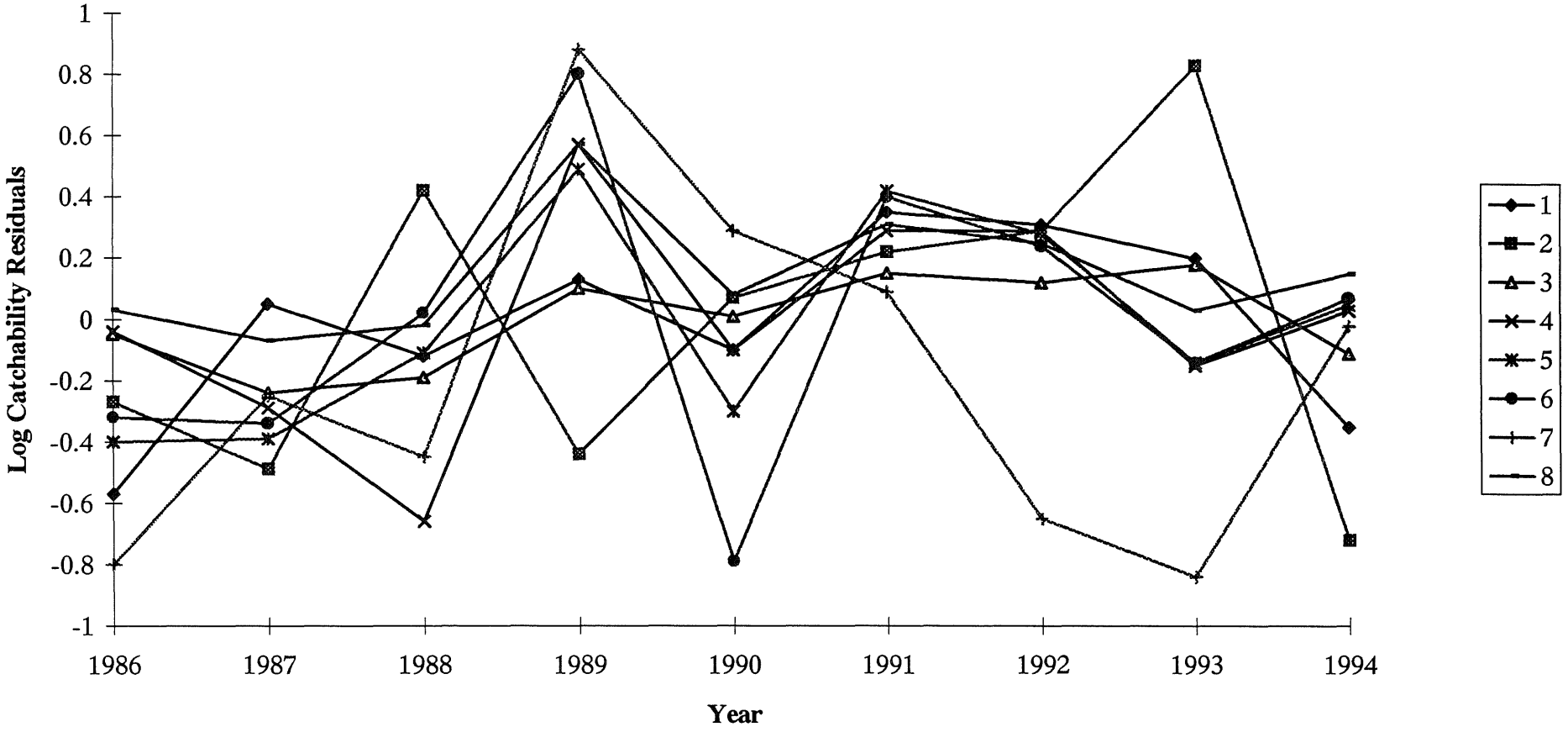
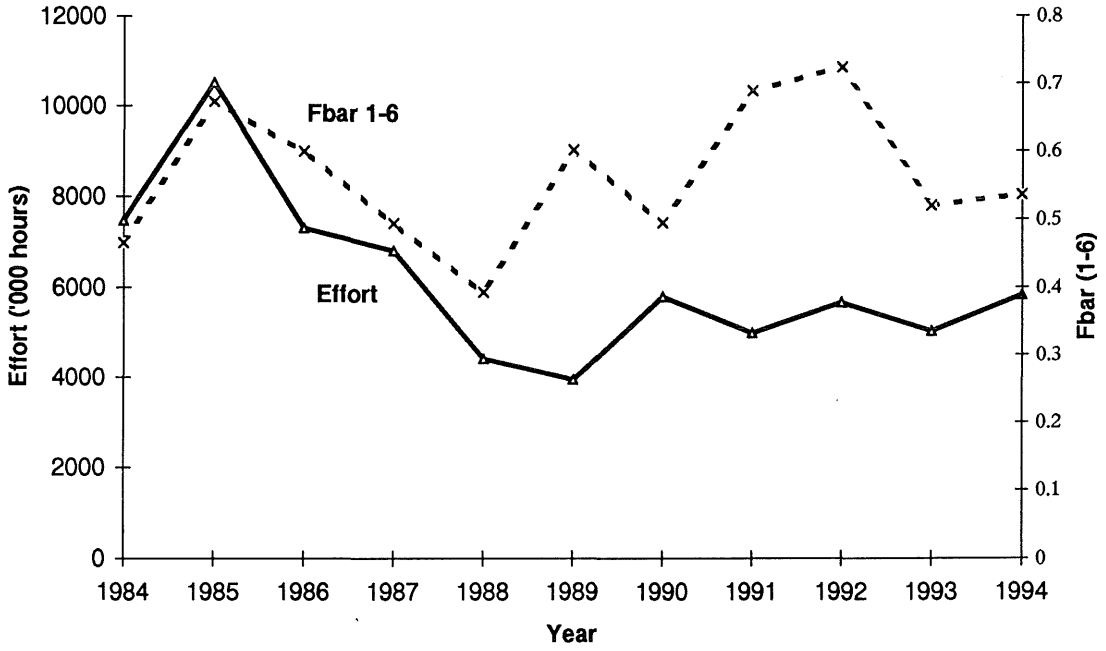


Figure 5.18.7 SW and S Portugal (FU's 28 and 29): Males - log catchability residuals from XSA



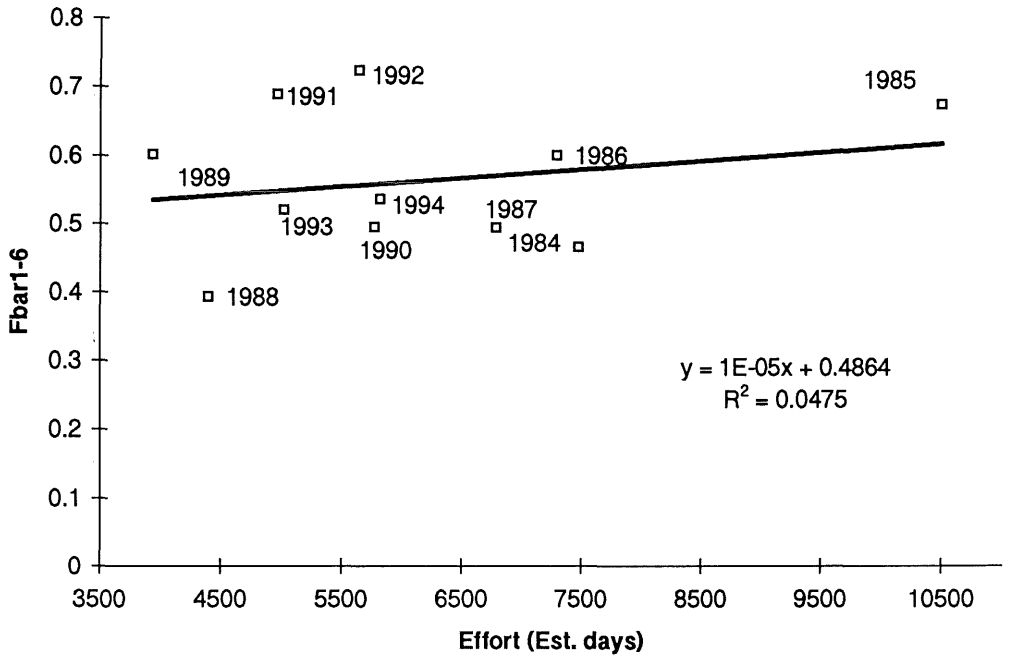


Figure 5.18.8 SW and S Portugal (FU's 28 and 29): Males - plot of effort and Fbar from XSA, together with their regression.

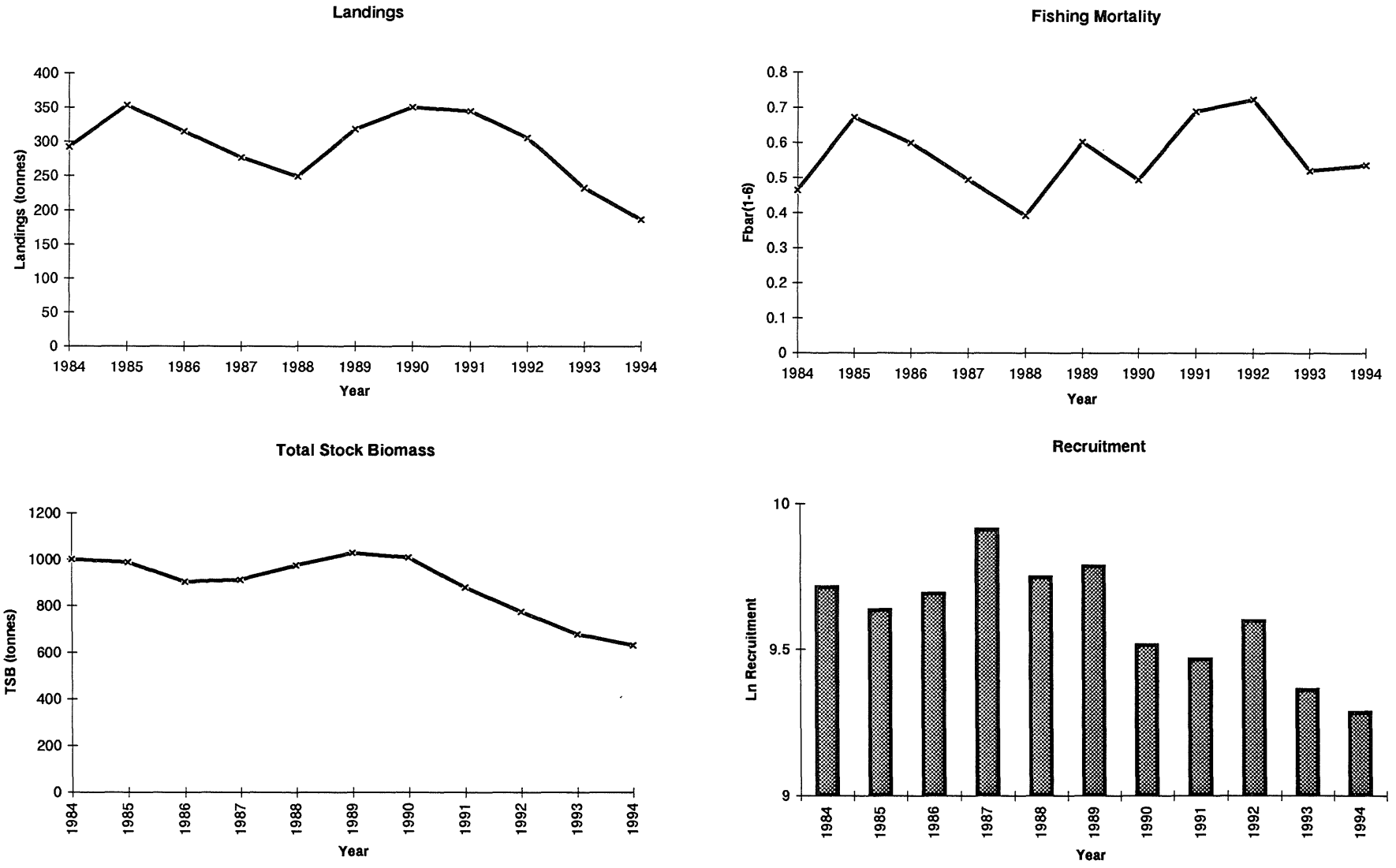


Figure 5.18.9 SW and S Portugal (FU's 28 and 29): Males - trends in landings, fishing mortality, total stock biomass, and Ln recruitment from XSA.

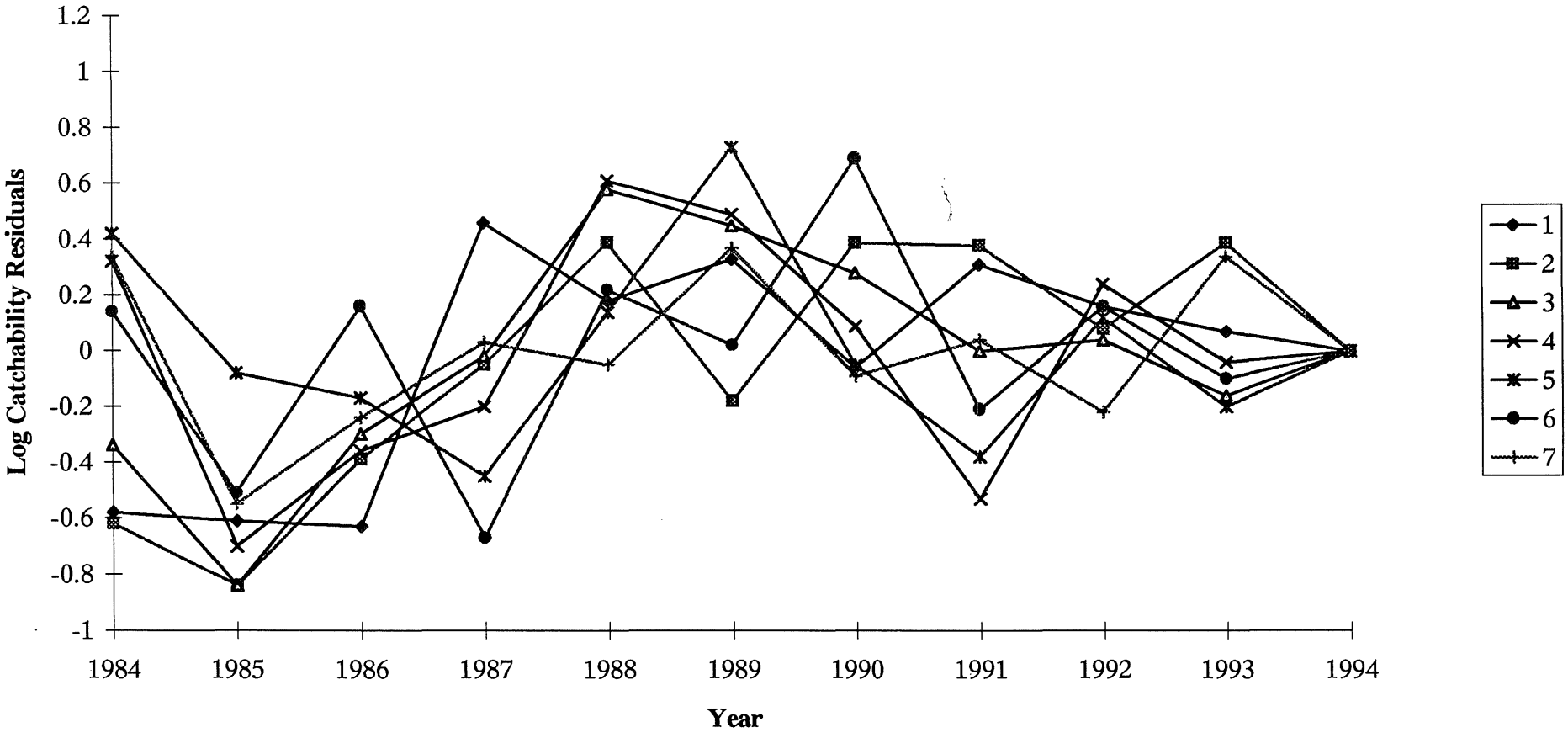


Figure 5.18.10 SW and S Portugal (FU's 28 and 29): Females - log catchability residuals form Laurec-Shepherd

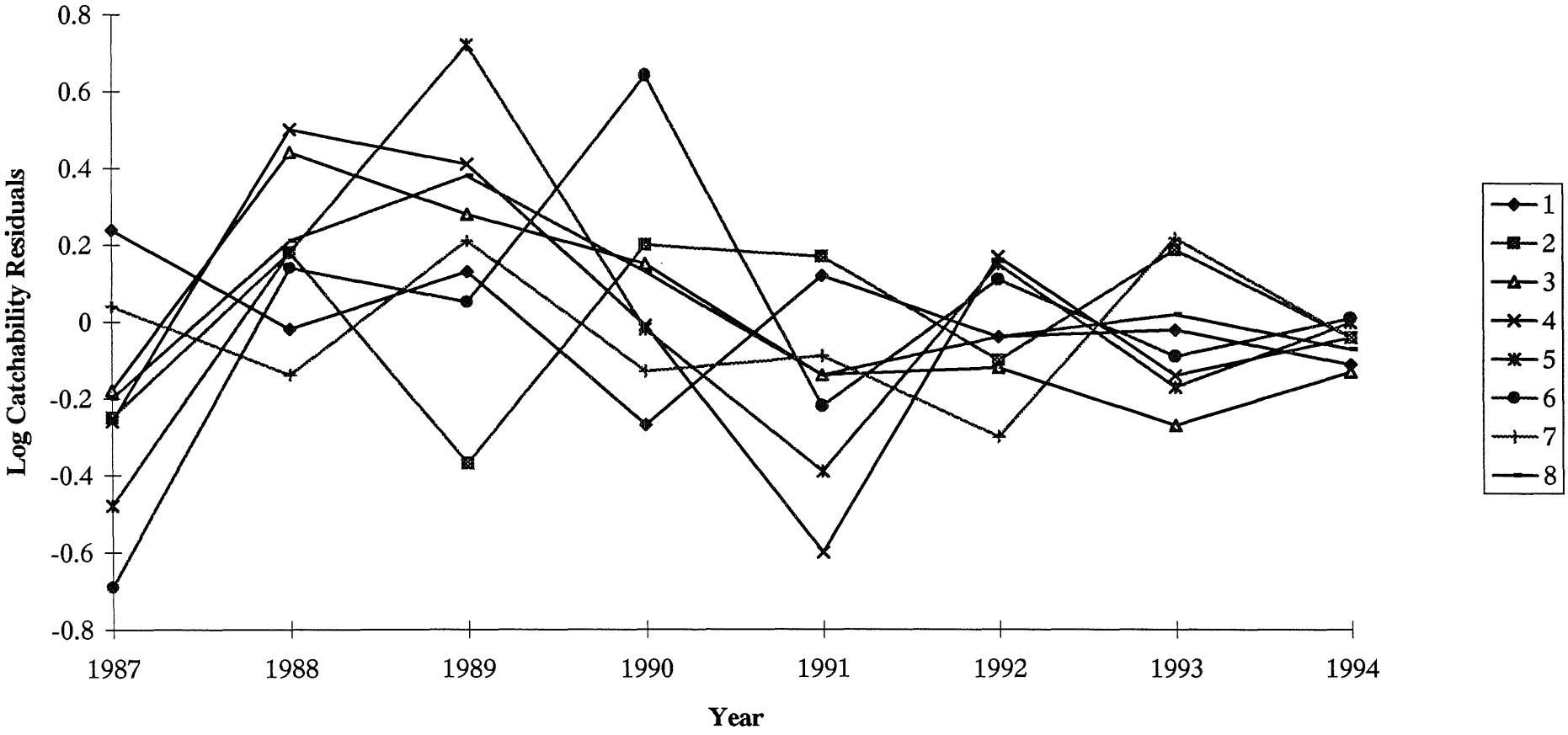
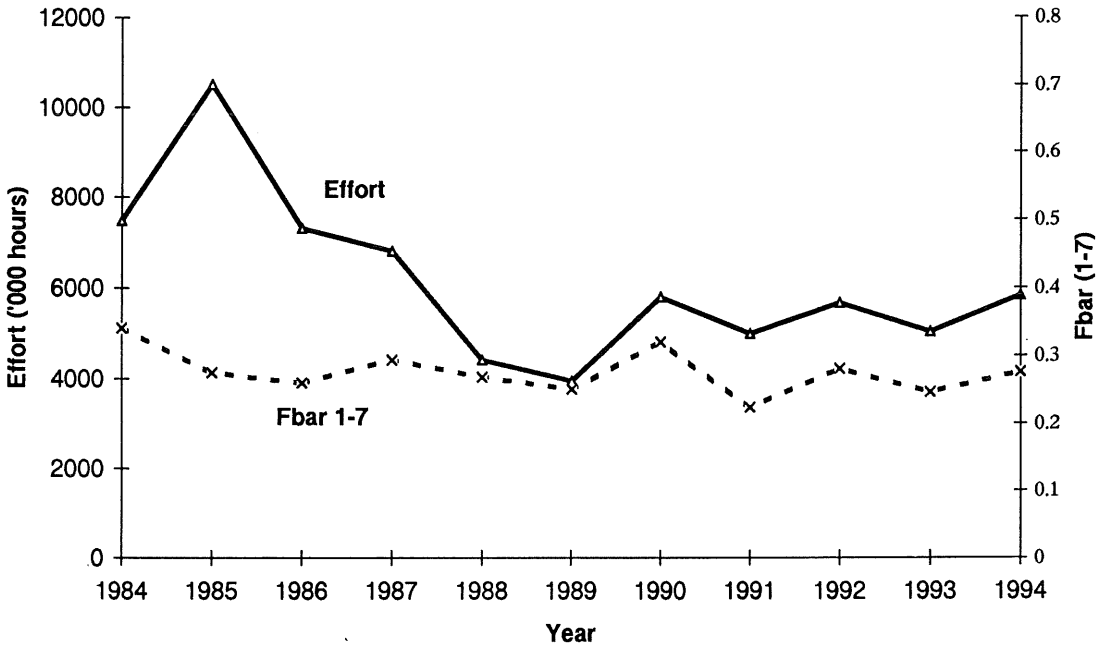


Figure 5.18.11 SW and S Portugal (FU's 28 and 29): Females - log catchability residuals from XSA



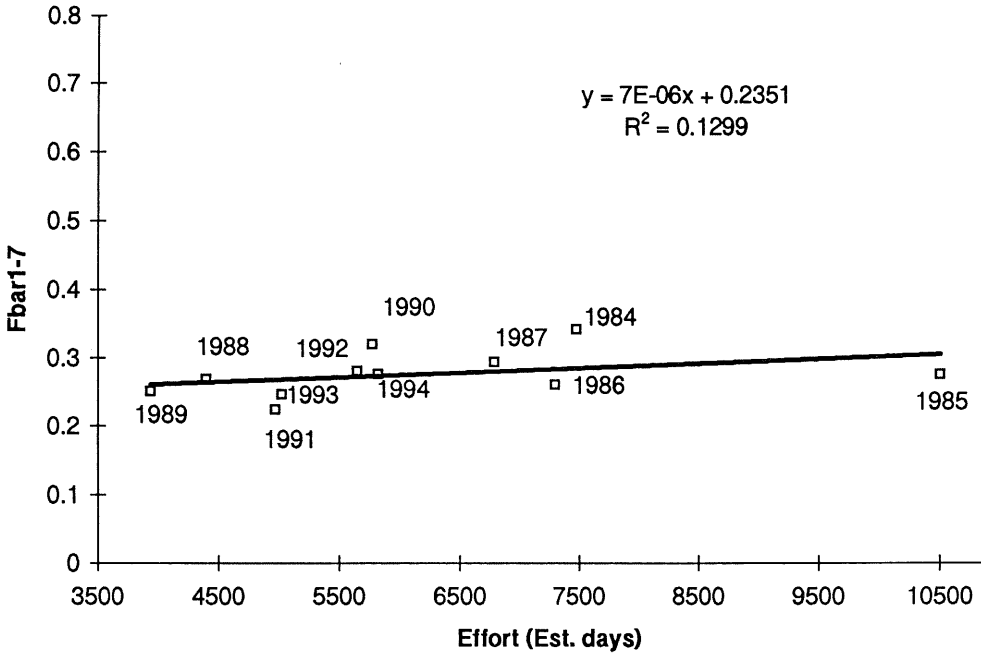


Figure 5.18.12 SW and S Portugal (FU's 28 29): Females - plot of effort and Fbar from XSA, together with their regression.

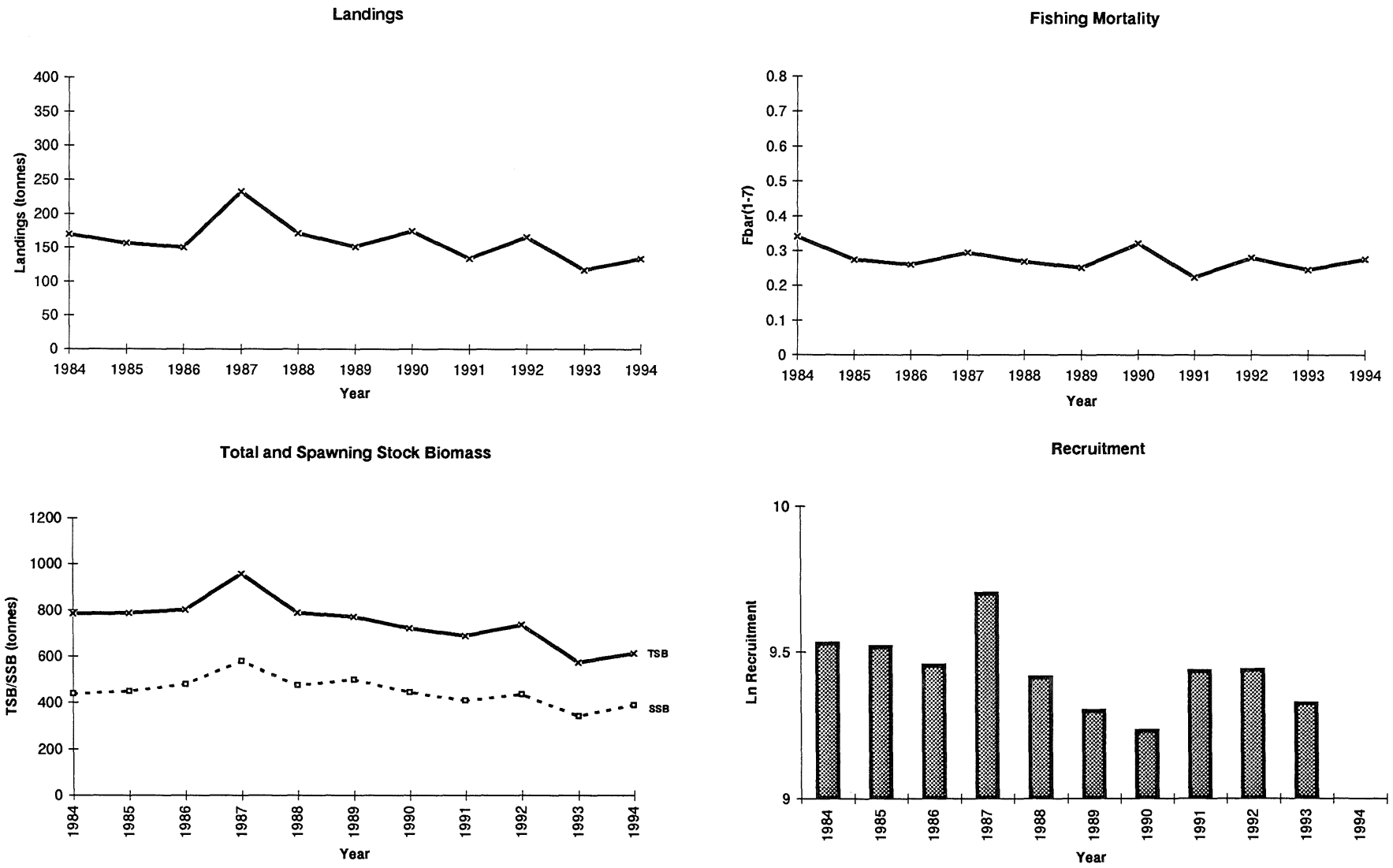


Figure 5.18.13 SW and S Portugal (FU's 28 29): Females - trends in landings, fishing mortality, total and spawning stock biomass, and Ln recruitment from XSA.

5.19. Division IXb and X (Management Area R)

Functional Units - none.

5.19.1. Summary of Division IXb and X (Management Area R)

Zero TAC to prevent misreporting.

6. MESH SELECTION AND ASSESSMENTS FOR *NEPHROPS*

Term of Reference (e) asked the Working Group to update mesh assessments, where appropriate, in the light of recent studies on mesh selection in *Nephrops* trawls.

Mesh selection ogives were reviewed by the Working Group in 1991 (Anon., 1991) and it was demonstrated that very different selection parameters, particularly selection range, had been used for different areas and mesh sizes. Standardizing for mesh size in use still produced different selection ogives between Functional Units, with some of this variation being attributed to differences in net design between areas. At that time there were promising results being derived from the application of the twin-trawl rig to estimate *Nephrops* selection parameters, and the development of gears which could improve the exploitation pattern on *Nephrops* (Anon., 1991).

The Working Group (Anon., 1991) had emphasized the need to improve enforcement of the existing mesh sizes, and drew attention to the benefits which could accrue if there was an improvement in the exploitation pattern which resulted in less discarding. They also highlighted several anomalies between Functional Units in the relationship between mesh size, L_{25} , and minimum landing size (MLS).

The Study Group on Life Histories and Assessment Methods of *Nephrops* Stocks (Anon., 1994a) gave a short review of some selectivity experiments from Belgium, Sweden, and Portugal.

6.1. Review of recent mesh selection experiments

The main thrust of recent trawl selection research has been to endeavour to improve *Nephrops* selectivity by steepening the selection ogive, and to provide more selectivity information on the gears currently used by commercial fisheries.

In the Swedish fishery from the Skagerrak and Kattegat (Division IIIa) the large amount (about 60% by weight) of undersized *Nephrops* in the catches suggests that the minimum landing size (40 mm CL) does not correspond to the selection parameters of the 70mm diamond-shaped mesh currently in use (Ulmestrand, pers comm). Experiments consisting of 28 hauls with a 70mm diamond mesh in the Skagerrak-Kattegat area gave an L50 of 20.1 mm CL.

To improve selectivity in trawls, studies were carried out with twin and trouser trawls having 50mm and 60 mm square meshes in a 6 to 8 metre extension piece and cod end (Ulmestrand, pers comm). Although the selection range was found to be no smaller than that for the diamond meshes, there was a higher probability of the square meshes remaining open during trawling. It was found that the square shaped mesh gave an L50 of 27.4 mm CL for the 50mm square-mesh and 39.7 CL mm for the 60 mm square mesh. A similar Portuguese experiment with 55 mm square meshes gave an L50 of 35.4 mm CL (Ferreira et al. 1992).

A Norwegian study (Tveite, pers comm) using a 22.5 mm grid angled backward from the top sheet of the trawl, gave a selection range the same as in the Swedish square mesh studies, and the selection parameters estimated were similar to those with 60 mm square meshes. A mesh assessment using the square mesh data showed that its introduction would give short-term loses and positive long-term gains compared to the currently used diamond-shaped mesh, assuming a high escape survival.

Research in the Belgian fishery (Polet and Redant, 1994) concentrated on codend selection in commercial side trawlers operating in the Botney Gut - Silver Pit area. Three net configurations were tested: a standard *Nephrops* trawl with a 70mm (single twine) codend, a standard trawl with a 90mm (double twine) codend, and the same trawl with a square mesh window in the top panel, in front of a 70mm codend. Escapes were captured in fine mesh codend covers which were kept clear of the codend by carefully arranged floats. Codend selectivity for *Nephrops* varied widely, most of the variability being attributable to vessel motion related to the weather conditions, with most escapes probably occurring during hauling. Rather surprisingly, the 90mm codend was found to be less selective than the 70mm codend, a phenomenon that could be related to the difference in netting construction, i.e. double twine. The L25 was only slightly above the legal MLS of 25mm CL and therefore in agreement with the general principle that the MLS of 25mm CL (Region 2) should be close to the L25.

Danish studies (Madsen and Moth-Poulsen, 1994) were carried out in the northern North Sea from a Danish commercial stern trawler. A conventional 70mm *Nephrops* codend and a similar codend with a 90mm square mesh panel window inserted in the top panel were tested in a twin trawl rig. Escapes were captured by fine mesh covers supported by hoops. Selectivity parameters and difference in catches of the target species, *Nephrops* and finfish bycatch species were estimated. Although the logistic function was found to describe fish selection ogives, the asymmetric complimentary log-log function gave the best description of *Nephrops* selection. Selection parameters were: L50 = 37.3 mm CL, L25 = 28.6 mm CL, SF = 0.51 and selection range 15.7mm CL.

Multi-rig studies of the Scottish fishery (Robertson and Ferro, 1993) demonstrated wide haul to haul variability. Several hauls showed a random bias in the catch of larger *Nephrops* to one side of a twin trawl or the other, while the combined *Nephrops* length frequency distribution for all hauls showed no such bias. It was suggested that the lack of *Nephrops* selection in many hauls could be explained by the loss of small *Nephrops* under the groundrope of the small mesh net, the greater drag of this net causing the groundrope to have lighter contact with the sea bed. Results indicated that there is little difference in 50% retention length for *Nephrops* in 70mm and 80 mm nets. In general, however, the whole gear selectivity by the twin net design was rather poor compared to the whole gear selectivity used in previous trials.

The results from phase 1 of an EU-funded collaborative study by Northern Ireland and Ireland are still undergoing analysis. A preliminary look at the data from twin-rig trawler experiments comparing whole net selection of 80mm and 70mm mesh nets suggests that the 80 mm net caught fewer *Nephrops* but the overall size composition was similar. There was large haul to haul variation in the results. It is planned to repeat the same experiments during phase 2 of the project in 1995, but this time using two similar single-rig vessels.

6.2. Consideration of the need to update mesh assessments

The results of the mesh selection experiments available to the Working Group suggest that there was no reason to make any significant changes to the selection parameters used in the mesh assessments carried out by the Working Group in 1990 (Anon., 1990). The main problem remains the poor selectivity of traditional trawls for *Nephrops* with a large selection range, and the considerable between haul variance found in mesh experiments. The Belgian experiment (Polet and Redant, 1994) clearly showed the impact of net construction on *Nephrops* selectivity. Any future legislation to improve the *Nephrops* exploitation pattern will need to address this problem. There continue to be considerable quantities of *Nephrops* being discarded in many of the more northern fisheries. An improvement in the exploitation pattern to reduce discards is desirable. Further studies to develop gears which are more selective for *Nephrops* should be encouraged. The development of the square mesh panel, now compulsory in some countries, has improved the exploitation by *Nephrops* trawlers on fish, particularly whiting (Briggs,1992) and haddock. Improvements in *Nephrops* selectivity are also likely to benefit fish.

Nephrops are being exploited by a wider range of trawl types and mesh sizes. For example, UK unilateral legislation compels trawlers to use 100mm mesh size for twin-rigs, except in Sub-area VI and VII (80mm) and the Fladen Ground (70mm). The actual mesh size in use is poorly recorded and it would be difficult to fully evaluate the impact of changes in exploitation pattern as the proportions of the landings made by various mesh sizes are generally unknown.

7. LONG-TERM ADVICE AND AREA AGGREGATION

The Working Group was asked in Term of Reference (d) to "evaluate the possibility of giving longer-term advice for *Nephrops* stocks and consider the effect on assessments and catch options of working at the different levels of the functional unit, management area and the current TAC zones".

7.1. The possibilities for long-term advice

The Working Group had a lengthy discussion on the possibilities for mid- or long-term management advice on *Nephrops* stocks, the main conclusions of which are summarized in this section.

For several reasons *Nephrops* seems to be particularly suited to a management system based on a system of mid- or long-term TAC or effort regulations :

a) The spawning stock biomass (SSB) of most *Nephrops* stocks seems to be relatively stable, and problems with rapidly decreasing SSBs are unlikely to occur. The burrowing behaviour of the egg-bearing females ensures that female *Nephrops* are only accessible to trawling for a fairly short period of time, which largely accounts for their very low Fs-at-age (as compared to the males), and the relatively stable SSBs.

b) Recruitment to the exploitable stocks also seems to be relatively stable, and there is no evidence of recruitment overfishing in *Nephrops* stocks. Independent estimates of the recruits are not available for any of the stocks assessed by the Working Group, but the estimates of the numbers of recruits given by the VPAs show very little variation in the levels of recruitment, as compared to most finfish stocks.

c) In many *Nephrops* stocks the CPUEs and/or LPUEs, particularly of males which usually account for the bulk of the landings, seem to be fairly stable or, in the worst case, to fluctuate without obvious trend. Male landings mainly depend on the levels of fishing effort, rather than on the fluctuations in CPUE or LPUE.

As opposed to recruitment overfishing, however, there are a number of *Nephrops* stocks which show clear signs of growth overfishing, particularly on the males. This is the case for example in the Firth of Forth (FU 8), the Irish Sea West (FU 15), and the Bay of Biscay (FUs 23+24).

Even in those stocks where there is a need to decrease fishing mortality, this could be done at a relatively slow pace, e.g. by a gradual reduction of the TACs (which could then be fixed for a number of years), or by a gradual reduction of the total fishing capacity of the fleet(s) allowed to participate in that particular *Nephrops* fishery. It can be expected that such an approach would be preferred by the fishing industry over the current system of annually adjusted TACs, since it would set clear long-term goals in terms of allowable catches and/or effort levels, to which the industry could then adapt its mid- and long-term strategies.

The long-term Y/R predictions based on length or age-based assessments, could be a helpful means to provide guidance on such long-term goals. In the case of *Nephrops*, the relatively stable levels of recruitment may remove some of the uncertainty associated with this approach when applied to finfish.

If a management system was devised to provide longer term control of fishing effort based on limited access to the fishery, it should be introduced over a sufficiently wide scale to prevent the diversion of effort from the "limited" to any "unlimited" *Nephrops* fisheries. Otherwise this approach could lead to severe increases in the levels of fishing effort on the less exploited *Nephrops* stocks, and to major conflicts of interest between the fleets which traditionally fish these stocks and the "newcomers" which enter the fishery. The uncontrolled diversion of effort from e.g. the whitefish to the *Nephrops* fisheries is a major reason for concern in most *Nephrops* stocks and, unless this problem is adequately resolved, it is likely to increase even further the pressure on a number of *Nephrops* stocks.

The Working Group also recognizes that the need for long-term advice may involve the need to perform a risk analysis in terms of safe biological limits. This, however, could be problematic in the case of *Nephrops*, particularly since the data required to do such an analysis are lacking for most stocks. As a preliminary step, attempts could be made to run simulations of "stock trajectories" into the future, making use of existing biological information and current stock estimates from the VPAs. Such an approach would permit an examination of the mid- and long-term outcomes arising from various scenarios in terms of exploitation patterns and levels, and biological features, such as recruitment trends or natural mortalities.

7.2. Working at the Functional Unit, Management Area and TAC level

During its 1984 meeting, the Working Group identified so-called Functional Units (FUs) for the assessment and management of *Nephrops* stocks (Anon., 1984). At the time, the identification of the FUs was based on various criteria, ranging from evidence on geographical isolation to the aerial distribution of fishing fleets and effort (Anon., 1989).

Since then, additional information has been collected on these FUs. Some of this information clearly showed that the distribution of *Nephrops* is restricted to particular types of sediment. Since these sediments only occur in certain parts of the European waters, the geographical distribution of *Nephrops* is also highly discontinuous, with areas

supporting *Nephrops* separated from each other, in some cases by quite large areas without *Nephrops*.

Adult *Nephrops* are known to be highly sedentary and territorial, migrating over very short distances of only a few 100 meters. This implies that the exchange of individuals between geographically isolated areas supporting *Nephrops* is restricted to possible drift during the planktonic larval stage. Unless evidence for such transfers can be produced, it seems logical to see these areas as independent and self-sustaining populations, and to assess and manage them accordingly. In the western Irish Sea, for example, there are strong indications that *Nephrops* larvae are retained by a gyral circulation in a thermally stratified upper water layer, and that the exchange of larvae between FU 15 (Irish Sea West) and FU 14 (Irish sea East) is limited, thus maintaining separate populations (Hill *et al*, in press).

The data collected since the early 1980s also show that, even within areas with a continuous *Nephrops* distribution, there may be smaller entities (called "stocklets"), with distinct biological features in terms of population density, sex ratio, growth rates, and natural mortality rates. The Working Group recognizes that "... it might not be practical to manage a fishery sub-divided into very small [management] units, although these may be biologically meaningful." (Anon., 1984).

Since 1990, when the Working Group was first asked to give management advice on the *Nephrops* stocks in European waters, the FUs defined in 1984 have been used as the standard unit for data collection and assessment studies. Only when data collection on a FU level proved impossible, have neighbouring FUs been grouped into larger entities (such as in the Celtic Sea, the Bay of Biscay and the Portuguese waters). This has not deflected the Working Group from its general view that, wherever possible, the FUs should be used as the standard level for assessment purposes.

In 1990, the FUs were defined in terms of statistical rectangles to standardize the collection and presentation of landings and effort data (Anon., 1990). It should be clear, however, that the linear boundaries of these groupings of rectangles do not necessarily correspond with the natural boundaries of the *Nephrops* populations, and that adjacent groupings of rectangles may include populations which, in reality, are clearly separated from each other.

Also in 1990, the concept of "Management Areas" (MAs) was introduced, mainly because the Working Group recognized that it was "... unrealistic to expect TAC management at the level of most of the individual Functional Units ..." (Anon., 1990). Essentially, these MAs are groupings of FUs showing similar states of exploitation and requiring a similar kind of management action.

Repeatedly, the Working Group has drawn attention to the potential risks of including FUs with completely different states of exploitation into one TAC area (see e.g. Anon., 1990, and Anon., 1994). Specific examples of potential problems inherent in the current TAC system were given in last year's Working Group report (Anon., 1994) and an actual example has been given under "TAC Areas" in Section 5.1.1.

In view of the above considerations, the Working Group re-iterates its earlier recommendations on FUs and MAs, viz. :

a) that, unless evidence is produced that the FUs used so far should no longer be considered as independent and self-sustaining populations, they should be adopted as the standard unit for data collection and assessment purposes

b) that *Nephrops* are more appropriately managed at a much smaller scale than is the case now, and that the indiscriminate grouping of FUs requiring completely different management action into large TAC areas (as is the case in ICES Sub-Areas IV and VII) should be avoided.

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